Iron and Steel ENGINEER

ENGINEERING SERVICE TO THE IRON AND STEEL INDUSTRY SINCE 1907

JANUARY, 1955

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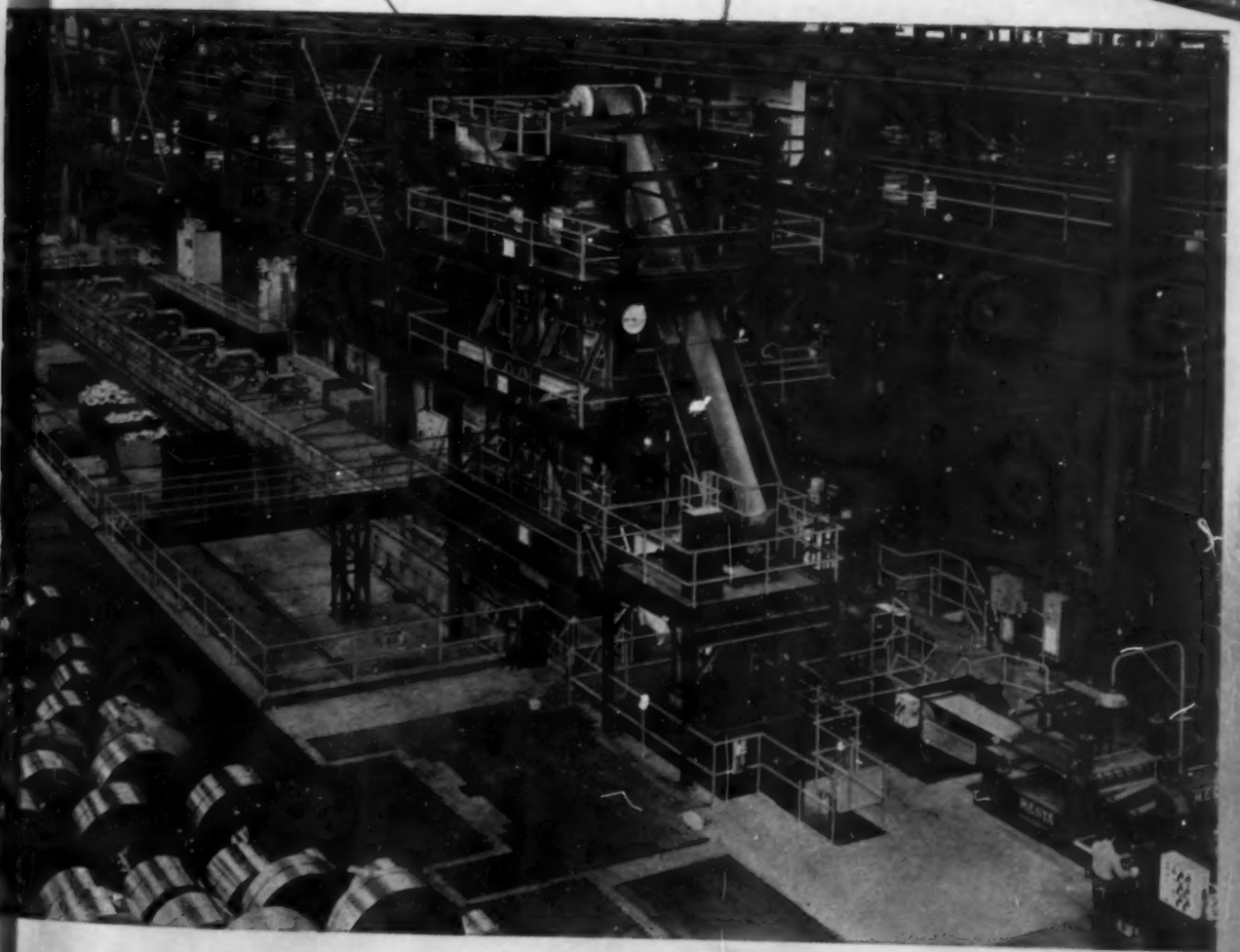
JAN 31 1955
DETROIT

Continuous galvanizing lines

Designed and Built by MESTA



Mesta 48" Continuous Galvanizing Line

Designers and Builders of Complete Steel Plants

MESTA MACHINE COMPANY

PITTSBURGH, PENNSYLVANIA

R v.32 Ja-De '55

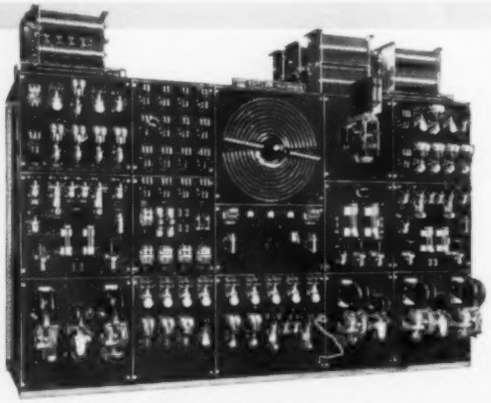
Versatile 4-high expands Athenia Steel's capacity...

speed, flexibility and high product quality afforded by Cutler-Hammer adjustable voltage control.

Athenia Steel rolls high-carbon steel to order . . . for razor blades and band saws, for watch springs and feeler gauges. High reputation for quality necessitated substantially increased production above that presently available from existing mill rolling facilities. In attaining this increased rolling capacity, there could be no sacrifice in quality of product. Athenia, therefore, ordered an E. W. Bliss 10 x 24 and 20, four-high reversing cold strip mill, with Cutler-Hammer control and Elliott Co. rotating equipment.

The adjustable voltage controller designed by Cutler-Hammer's engineers amply provided the flexibility needed to satisfy the wide range of product metallurgy and cross-section, afforded the increased speeds needed for the higher production rates and still maintained the high quality of Athenia's product. Coupled with these outstanding results were the ease and rapidity with which the entire mill installation was accomplished.

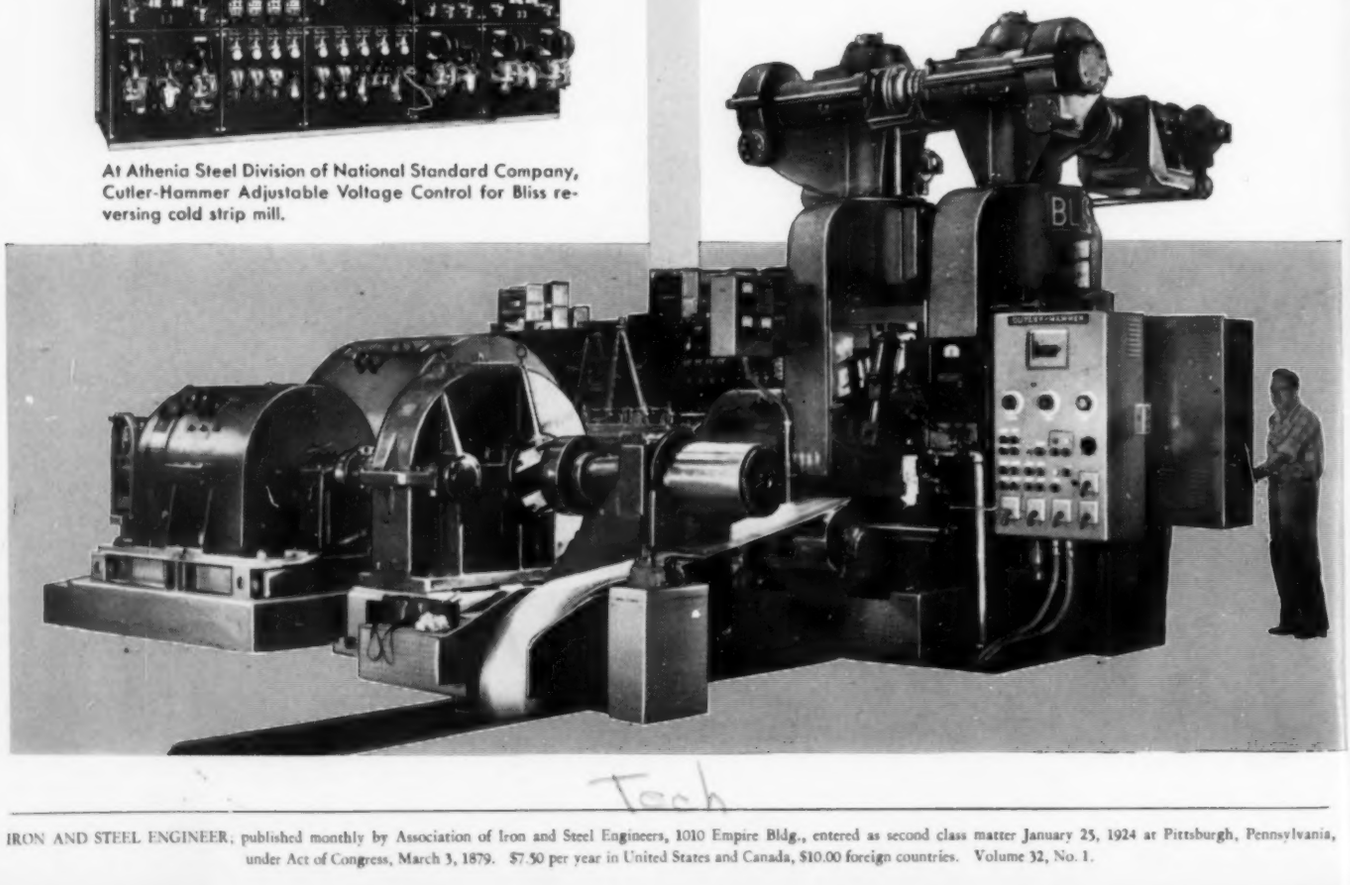
On past performance alone can you judge mill machines, mill motors, mill control. And no control manufacturer has the past-performance record of Cutler-Hammer whether you look at that record for length, for breadth and scope, or for the individual motor control achievements responsible for progress in the vast and varied steel mill field. Cutler-Hammer has *always* led here and you can look to Cutler-Hammer in perfect security whether you need adjustable voltage control, *automation* type of components or any other type of mill duty control. Call in Cutler-Hammer early, and save time, money, false starts and delays. CUTLER-HAMMER, Inc., 1269 St. Paul Avenue, Milwaukee 1, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto, Ontario.



At Athenia Steel Division of National Standard Company, Cutler-Hammer Adjustable Voltage Control for Bliss reversing cold strip mill.

CUTLER-HAMMER
MOTOR CONTROL
C-H

LOOK TO CUTLER-HAMMER MILL EXPERIENCE . . . AS BROAD AS IT IS LONG



Tech

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● The majority of America's homes must be rebuilt or remodeled. Sixty-seven percent of homes are now over twenty years old; fifty percent are over thirty years old. Since 1950, three million new homes have been built but the population has increased by nine million and continues to increase. *The prediction for 1955 — one million, three hundred thousand homes — an increase of 100,000 over 1954.*

Homes require great tonnages of steel, copper, brass, aluminum, other metals, rubber and plastic. Construction and equipment of a modern six-room house may take up to 7,000 pounds of steel alone, plus tonnages of other metals and materials.

Are your plants equipped to meet volume demands at proper cost or are you losing sales position by inefficient, high-cost equipment? Good equipment brings down production costs.

This Continuous Butt Weld Pipe Mill produces ½" to 1½" pipe up to 1,250 feet per minute. How does this speed compare to the speed of your pipe mill? In addition to pipe and tube mills, Aetna makes other basic machines for producing, processing and fabricating steel, copper, brass, aluminum, rubber and plastic, including: Continuous Coating Lines, Rolls, Flat-Rolled Finishing Equipment, Drawbenches and related equipment; Machinery for Rubber and Plastic.

Good equipment keeps down production costs.

SUBSIDIARY and ASSOCIATED COMPANIES

Head Wrightson Machine Company, Ltd., Middlesbrough, England — Great Britain, Finland, Sweden, Norway, Denmark, Union of South Africa, Northern and Southern Rhodesia.
Aetna-Standard Engineering Company, Ltd., Toronto, Ontario, Canada.
M. Castellvi, Inc., New York, N. Y. — Mexico, Central and South America.
Societe de Constructions de Montbard, Paris, France — France, Belgium, Holland, Luxembourg, Switzerland.
Demag Aktiengesellschaft, Duisburg, Germany — Germany, Austria, Yugoslavia, Greece, Turkey, Egypt.
Compagnia Italiana Forme Acciaio, Milano, Italy — Italy.
Aetna-Japan Company, Ltd., Tokyo, Japan — Japan.
Hale & Kullgren, Inc., Akron, Ohio — Representative for the Rubber Industry.
Standard Engineering Company, Ellwood City, Pa.
Trans-World Traders, Pittsburgh, Pa.

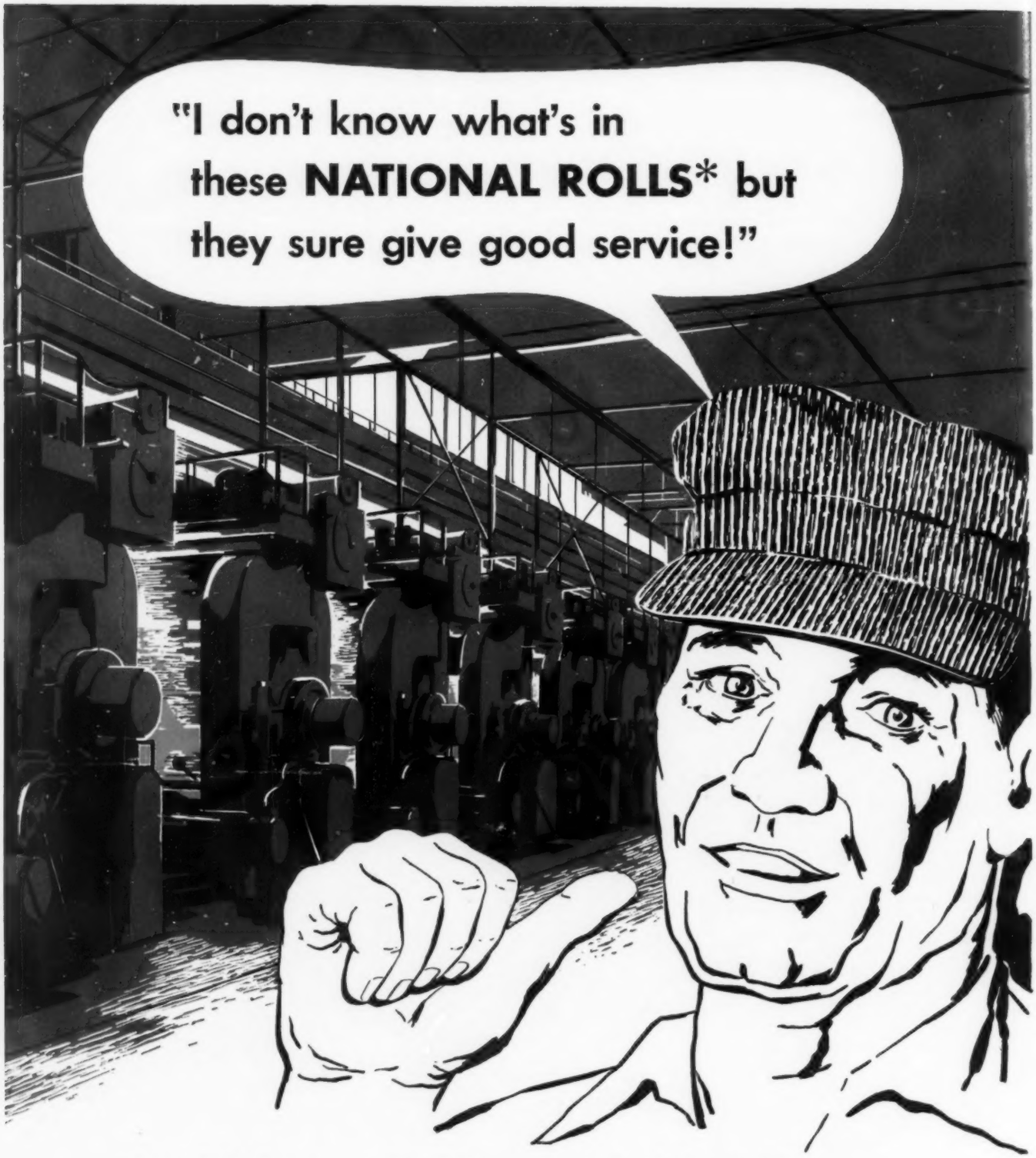
Designers and Builders to the Ferrous, Non-Ferrous, Leather, Rubber, and Plastic Industries

THE AETNA-STANDARD ENGINEERING COMPANY • PITTSBURGH, PA.

Aetna-Standard

PLANTS IN WARREN, OHIO • ELLWOOD CITY, PENNSYLVANIA

GOOD EQUIPMENT BRINGS DOWN PRODUCTION COSTS



*You'll find that you will get the most out of a National Roll because into all National Rolls go only the best of materials and craftsmanship . . . so for longer, uninterrupted service, specify National Rolls.

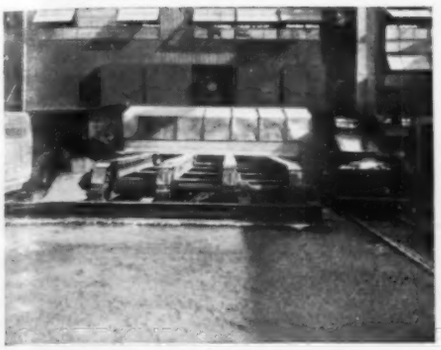
THE NATIONAL ROLL & FOUNDRY CO.

Avonmore, Pennsylvania

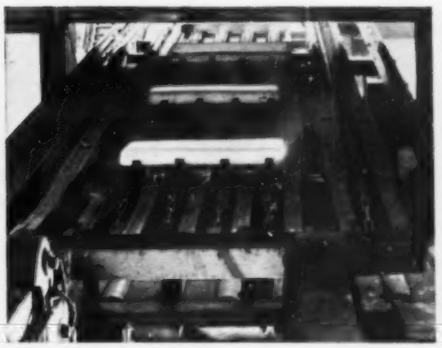
Specialists in Iron, Alloy Iron and Steel Rolls and Castings, Steel Armor Castings

NATIONAL ROLLS

How LINK-BELT helps cut costs of handling steel in every form



SLABS—Up to 70 tons of hot slabs are easily carried by 4-strand chain conveyor.



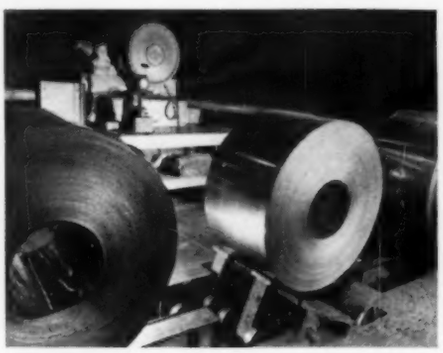
BILLETS—Dependable Link-Belt chain with pusher attachments transfers steel billets.

PLATES are transferred from hot run to cold run tables on 51 strands of steel chain.

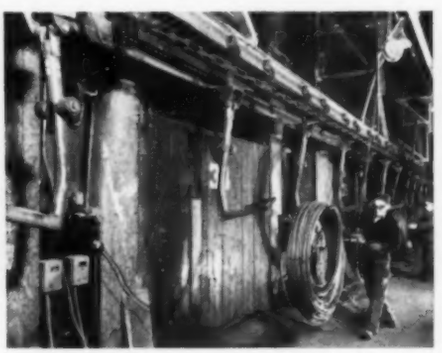
TUBES—12 endless strands of Class H pintle chain serve this modern pipe cooling rack.

SKELP—Hot skelp moves to the reels on a Link-Belt steel apron conveyor 108 in. wide.

SCRAP—At this mill, scrap is handled on a completely mechanized Link-Belt system.



COILS—Up to 75,000-lb. coils are carried on Link-Belt conveyors—gently, safely.



ROD COILS—Coils are tied as they move on 850-ft. Link-Belt overhead trolley conveyor.

MILL SCALE recovery was boosted from 250 to 475 tons a week by Straightline Collectors.

FOR every step of your steel handling, Link-Belt conveyors offer many real economies.

- First, you can step up capacity with mechanization that eliminates many rehandling bottlenecks.
- Second, more efficient handling methods cut costs by releasing valuable manpower for other work.
- Third, you'll find waste goes down and yield up because mechanization minimizes the chances of careless handling.
- Last, but not least, safety is improved. No confusing cross traffic. Workers can be kept clear of hazardous locations.

Remember, Link-Belt builds a complete line of conveying equipment, can help you get the type best-suited to your overall system requirements. For expert engineering cooperation, call your nearby Link-Belt salesman today.

LINK-BELT

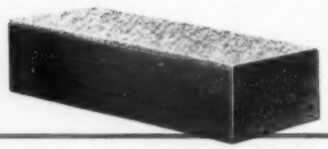
MATERIALS HANDLING, PROCESSING & POWER TRANSMISSION EQUIPMENT

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13,470

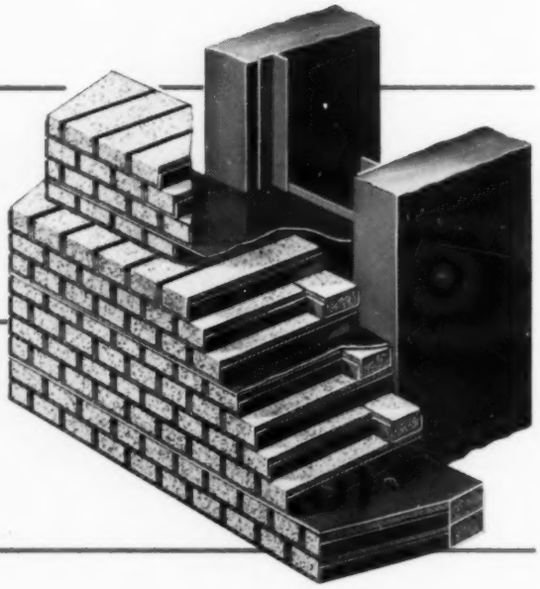
HARBISON-WALKER

CHROMEX B—an extremely hard fired chrome-magnesite refractory having unusual constancy of volume and strength at high temperatures.

METALKASE—the pioneer metal-encased basic brick possessing an unusual combination of desirable properties.



CHROMEX—a chemically-bonded chrome-magnesite brick having excellent spalling resistance.



Typical section of open-hearth furnace front wall built of METALKASE. For maximum stability steel plates are used at every fourth course vertically. These are tack-welded to steel bars which in turn extend behind the buckstay and are free to move vertically.

MAGNEX—a chemically-bonded magnesite-chrome brick—highly basic and of low spalling tendency.

H-W MAGNESITE—the standard burned magnesite refractory for more than half a century.

THERMAG—a hard burned magnesite-chrome refractory possessing enhanced physical properties.

H-W CHROME—a hard burned chrome brick especially adapted for various specific uses.

FORSTERITE—the only commercially produced magnesium-silicate brick—suited for certain particular applications.

H-W PERIKLASE—an exceptional high-magnesia brick of unusual high-temperature stability.

OTHER HARBISON-WALKER BASIC REFRACTORIES

H-W MAGNAMIX (for monolithic banks and bottoms)
H-W C-MIX (92% magnesia ramming mixture)
H-W WASHINGTON DEAD BURNED MAGNESITE GRAINS
H-W SPECIAL FURNACE CHROME
PLASTIC THERMOLITH BATCH
THERMOLITH AND OTHER BASIC CEMENTS

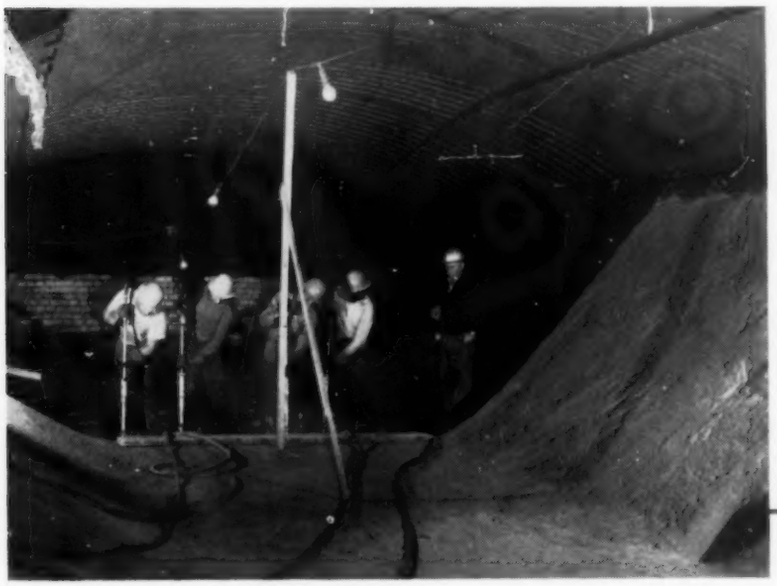
BASIC REFRACTORIES

serve the varied and specialized needs for metallurgical furnaces

Shown at the left are the various brands of Harbison-Walker basic refractories. They include classes especially suited for each particular need in open-hearth and electric steel furnaces, soaking pits and various other furnaces.

Among the brands listed here are types and classes established as standards for furnaces employed in the metallurgy of ferrous and non-ferrous metals and alloys.

The superior performance of Harbison-Walker basic refractories is the result of: (1) a thorough knowledge of the requirements gained through close cooperation with producers of metals and alloys; (2) extensive and continuous original research; and (3) the use of top quality raw materials processed in modern plants under close laboratory control. Harbison-Walker uses the most up-to-date methods and equipment to insure the quality and dependable uniformity of basic refractories.



(*Above*) In basic linings of electric furnaces, METALKASE are used in the upper side walls and provide maximum resistance to spalling and to slagging action. Lower side walls and sub-bottom are built of H-W MAGNESITE. MAGNAMIX or H-W DEAD BURNED MAGNESITE forms the monolithic banks and bottom.

(*Left*) H-W MAGNAMIX bottom section in a new open-hearth furnace. Air hammers are used to ram the material into a dense, monolithic working hearth of the desired thickness and contour.

HARBISON-WALKER REFRACTORIES CO.

AND SUBSIDIARIES

GENERAL OFFICES • PITTSBURGH 22, PENNSYLVANIA

World's Largest Producer of Refractories

Two 30 ton, 75 ft. span Bedford magnet cranes with 15 ton bucket auxiliaries working over the cinder yard—used as skull crackers in Detroit Steel Company's mill at New Boston (Portsmouth), Ohio.

Bedford Steel Mill Cranes are individually engineered for each specific application

In steel mills, power plants and throughout heavy industry, wherever superior performance is *expected*, experienced owners are enthusiastically recommending Bedford cranes.

Further proof of the superiority of Bedford cranes is found in the high percentage of *repeat orders* from important owners through the years.

Built to the most modern standards and backed by more than 52 years of specialized crane building *and utilization* experience . . .Bedford cranes have won fame the world over for advanced design and for safe, smooth, dependable performance.

Available in all types and sizes . . . from 5 tons to 350 tons, and up, for all kinds of indoor and outdoor services . . . each Bedford crane is individually engineered and precision built for its specific application.

You are invited to consult a Bedford engineer on your next crane problem . . . with all the facts on the table we believe you too will make your next crane a Bedford.

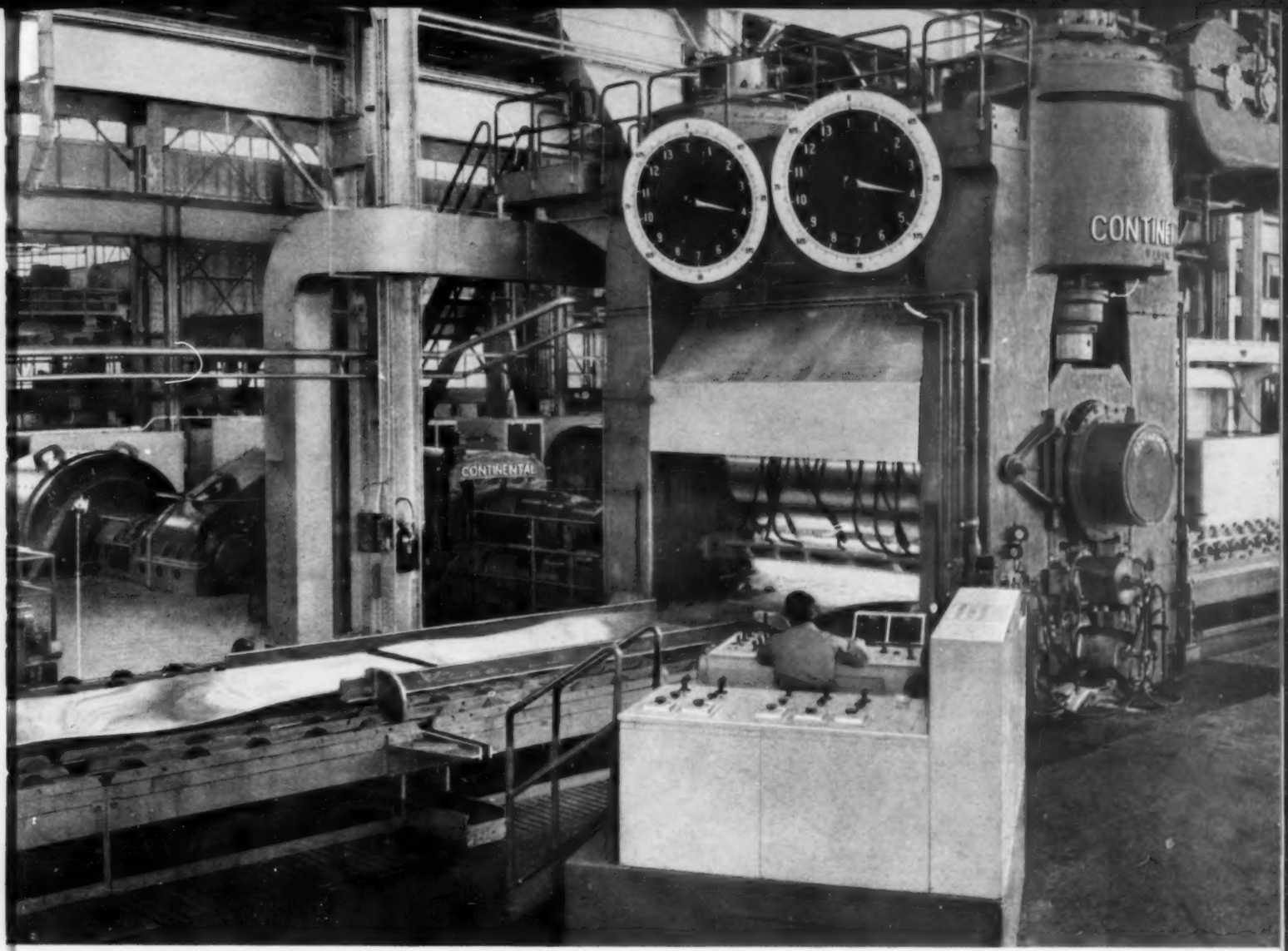
New York Office: 280 Madison Avenue
New York 16, N. Y., Phone MUrray Hill 5-0233

Pittsburgh Office: Oliver Building, Room 1241
Phone ATlantic 1-0136

STEEL MILL CRANES BEDFORD

BEDFORD CRANES SERVICE

BEDFORD FOUNDRY & MACHINE COMPANY, INC. • BEDFORD, INDIANA



144-inch Four-High Tapered Plate Mill, Aluminum Company of America, Davenport, Iowa.

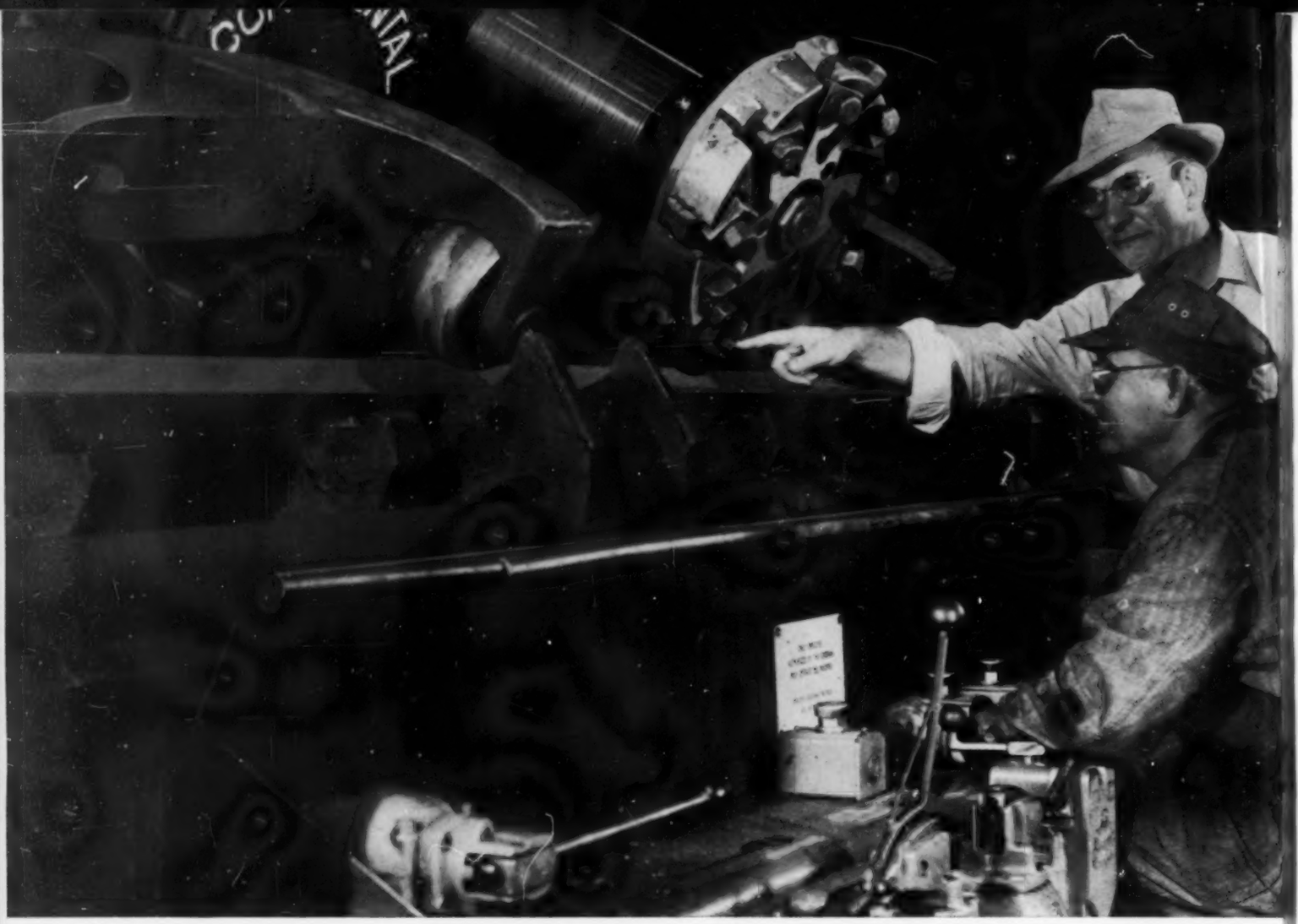
Now! A high-precision Plate Mill by Continental

This heavy-duty Continental 144-inch four-high plate mill built for Aluminum Company of America's Davenport, Iowa, Works produces a uniform, predetermined end-to-end taper in both sheet or plate aluminum alloy, as well as the full range of commercial plate. Both hot and cold rolling operations are performed on this mill. Gauges and tapers are maintained to the most exacting requirements. Continental produces—from preliminary engineering to satisfactory operation—varied types of ferrous and non-ferrous mills, with complete auxiliaries, for flat and shape rolling.

Plants at
East Chicago, Ind. • Wheeling, W. Va. • Pittsburgh, Pa.
Copes-Vulcan Division, Erie, Pa.

CHICAGO · PITTSBURGH

CONTINENTAL
Foundry & Machine
Company



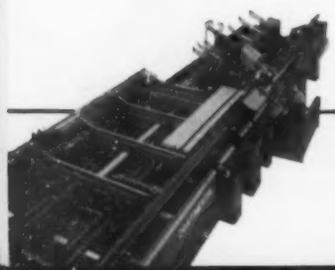
"This is the Continental Chipper that reduced our billet conditioning costs 67%"

WISCONSIN STEEL DIVISION
INTERNATIONAL-HARVESTER CO.

In actual service, the Continental Chipper reduced billet chipping costs 67% by increasing chipping speeds and reducing time-consuming handling.

The Continental Chipper applies the principles of automation to billet conditioning by providing a completely mechanized continuous system. All billet handling is accomplished mechanically and a new method that travels the billet beneath a stationary, rotating cutter head is used. Complete manipulation and accurate chipping is obtained from a single control point and one operator. New high standards in chipping efficiency and speed are being set.

Auxiliary equipment, such as the Unscrambler and mobile inspection car, is available to supplement the operation of the Chipper. The Unscrambler separates stacked or mixed billets and feeds them mechanically to an inspection car which provides full maneuverability for inspection and carries the billet to the Chipper feed bed or delivery point. Ask your Continental representative for a complete description.

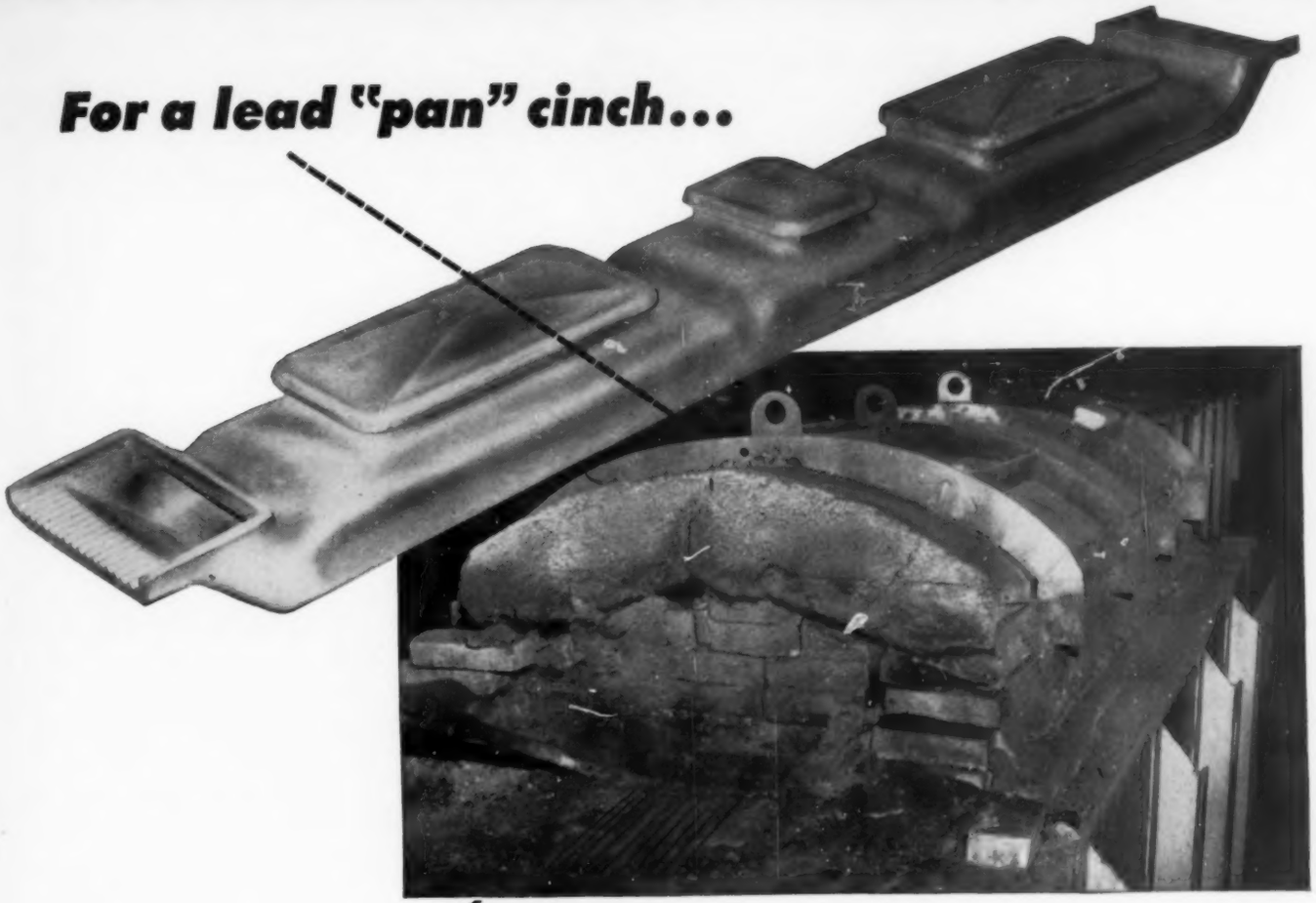


Plants at
East Chicago, Ind. • Wheeling, W. Va. • Pittsburgh, Pa.
Copes-Vulcan Division, Erie, Pa.

CHICAGO · PITTSBURGH

CONTINENTAL
Foundry & Machine Company

For a lead "pan" cinch...



it's THERMALLOY* to outlast cast iron by 479 days!

A large steel and wire company uses a double-lead patenting furnace to give good drawing qualities to wire. In this process, wire is drawn through a "lead" pan enclosed in the furnace where temperatures range from 1600 to 1650°F.

Previously, cast iron "lead" pans were used . . . and the furnace had to shut down nearly every 21 days because the pan burned out and needed replacement. Then, a Thermalloy "lead" pan with integrally cast sinkers was installed. *To date, this pan has over 500 days of service* . . . saving this company expensive hours of repair and down time.

This is just one example of how a Thermalloy heat-resistant casting has helped a manufacturer to realize more economy in heat-treating parts. Do you have a similar need for Thermalloy in retorts, furnace parts, trays, racks, pots or muffles? Call in an Electro-Alloys engineer for full information, or write Electro-Alloys Division, 6004 Taylor Street, Elyria, Ohio.

THERMALLOY "LEAD" PAN ADVANTAGES

- Resists air-line attack, scaling and oxidation.
- Higher strength prevents sagging and distortion.
- Less weight means easier installation and less maintenance of supporting arches.
- Greater resistance to abrasion.

*Reg. U. S. Pat. Off.

AMERICAN Brake Shoe COMPANY

ELECTRO-ALLOYS DIVISION
ELYRIA, OHIO

SPEED CASTING OPERATIONS WITH THIS THERMAL LADLE HEATING BURNER

MANY COST-SAVING APPLICATIONS...

The extreme high heat release rate of the THERMAL burner makes possible the application of this ladle heating installation without altering your existing facilities or production methods.

1. Reduces ladle pre-heating time as much as 75%.

2. Maintains pouring temperatures during continuous casting operations.

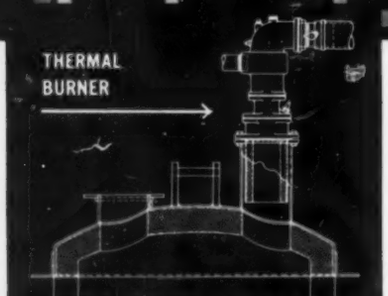
3. Can pre-heat or even melt-down a charge within the ladle.

4. Atmosphere can be controlled as needed.

5. High velocity can actually stir the molten metal.

QUICK, ECONOMICAL INSTALLATION...

THERMAL ladle heating installations are available complete with ladle covers or ready for mounting to your present cover. All necessary valves, blower, pump, etc., are supplied for immediate application.



SIMPLE, RUGGED CONSTRUCTION

The THERMAL High Velocity Burner (for gas or oil) is fired through a small opening in the ladle cover. High velocity insures distribution of heat throughout the ladle.

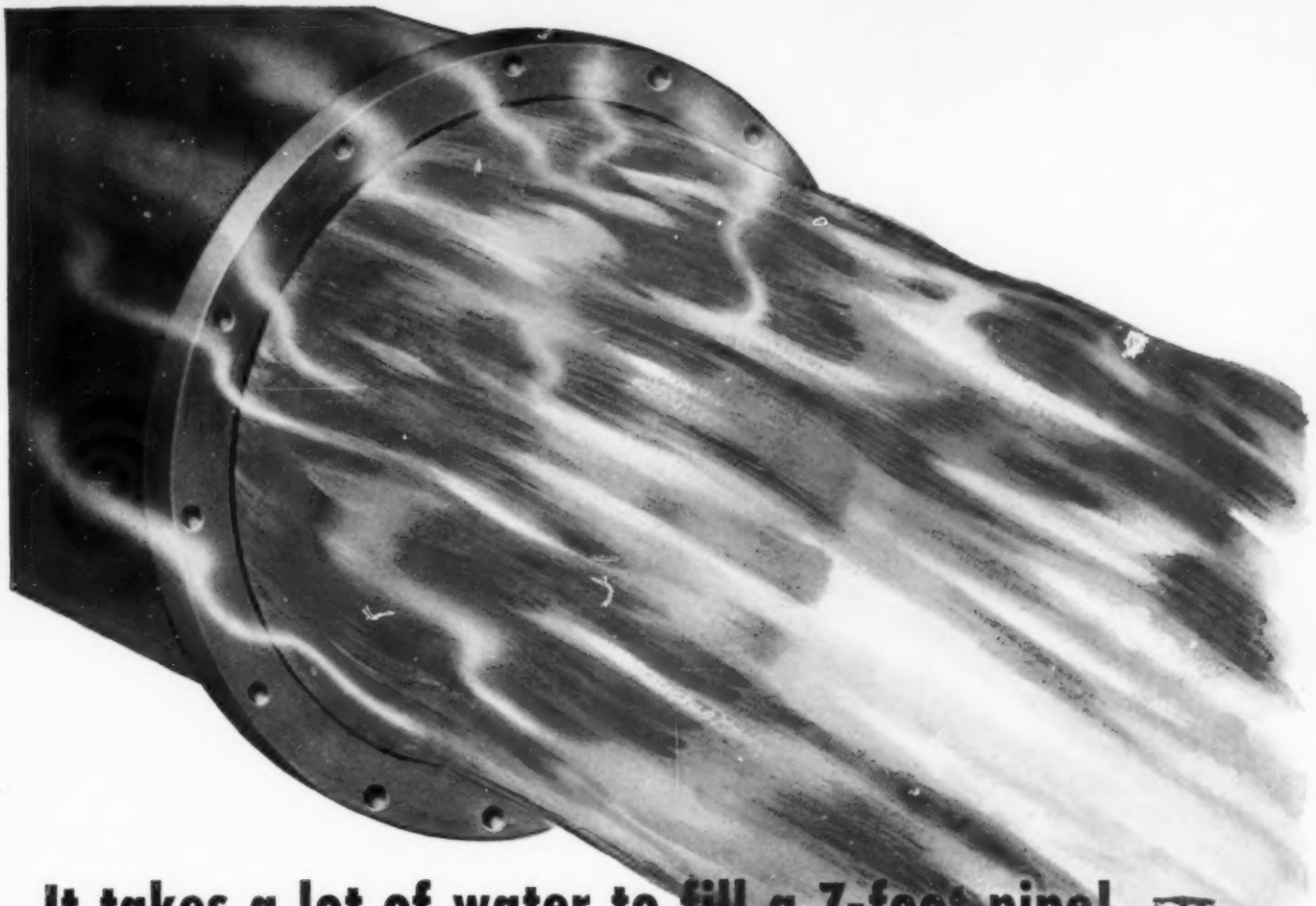
OTHER THERMAL PRODUCTS & SERVICES

Gas, Oil & Combination Gas-Oil Burners • Heat Exchangers • Air Heaters • Submerged Combustion • Combustion & Heat Transfer Engineering

THERMAL

Thermal Research & Engineering Corp.

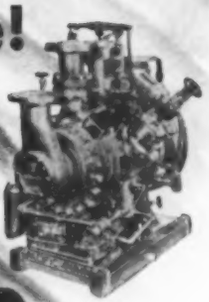
CONSHOHOCKEN • PENNSYLVANIA



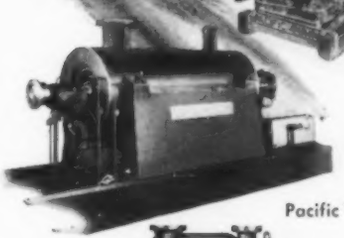
It takes a lot of water to fill a 7-foot pipe!

To bring the hot water to all the Pacific Boiler Feed Pumps placed in operation in 1953 would require a pipe 7 feet in diameter...

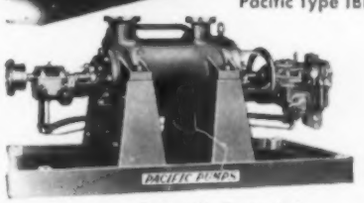
Today practically all of the large power generating companies throughout the United States have one or more Pacific Pumps in feed water service. Pacific Boiler Feed Pumps now operating include small vertical type units handling 47,700 pounds per hour at 710 psig discharge pressure—to very large horizontal type units handling 800,000 pounds per hour at 2430 psig discharge pressure. Bulletins 106, 109 and 118 giving details available on request.



Pacific Steam Turbopump

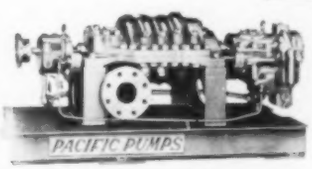


Pacific Type IBF



Pacific Type ABF

Specify **Pacific**
CENTRIFUGAL BOILER FEED PUMPS



Pacific Type JBF

Pacific Pumps inc. HUNTINGTON PARK, CALIFORNIA
ONE OF THE DRESSER INDUSTRIES
Export office: Chanin Building, 122 East 42nd Street, New York
Offices in all principal cities

BF-19

Illinois mill: 24 holes

Illinois mill: 12 holes

271 PITS

In the steel industry's current modernization program, Surface Combustion has installed 271 one-way fired soaking pits, with a capacity of 20 million tons a year. That's nearly 90% of the pits built since World War II. We believe there is a simple explanation for these facts: Surface Combustion is known for the quality of engineering that developed the jet pump recuperative system and for the experience gained in almost 50 years of working with steelmakers. 'Surface' means equipment that performs up to the customer's requirements, or better.

SURFACE COMBUSTION CORP.
Toledo 1, Ohio

Kentucky mill: 20 holes

Michigan mill: 20 holes

Pennsylvania mill: 15 holes

New York mill: 16 holes

Pennsylvania mill: 16 holes

Pennsylvania mill: 30 holes

IN 7 YEARS

20 MILLION TONS/YR.

Mexican mill: 6 holes

Ohio mill: 13 holes

Surface

STEEL MILL FURNACES

Instruments guide industrial waste treatment

Industry knows that *water*, once taken for granted, has become a precious raw material in all too short supply. Guarding against stream pollution is more than an altruistic plan to make life happier for fish.

Waste treatment is as much a part of the over-all production operation as stamping, machining, or mixing of raw materials. The advancing technology of waste treatment now recognizes the problem as one of *chemical engineering*. The same techniques that have sparked progress in process operations are being successfully integrated in the operation of efficient, automatic waste treatment systems.

Engineered Honeywell control

Manually-regulated, batch-type waste treatment systems are fast giving way to fully automatic, continuous processes which make full use of dependable Honeywell instrumentation . . . including the same advanced controls which have outstanding records in scores of industrial operations. With pinpoint accuracy, round-the-clock precision, instruments analyze chemical concentration and automatically adjust the addition of reagents . . . provide a permanent record of effluent characteristics, positive evidence of operating performance. The waste treatment process runs continuously with increased throughput, reduced storage capacity, and minimum operating costs.

Outstanding economies

The many plants where waste treatment operates under control of Honeywell engineered instrumentation report:

- Lower construction costs; equipment can be designed smaller . . . much storage capacity even eliminated.
- More consistent, more satisfactory operation.
- Reduced operating and maintenance costs.
- Considerable chemical savings.
- Reduced costs of laboratory analysis.
- Elimination of damage due to equipment overloads.

The experienced Honeywell staff will work with you . . . or with your consulting engineers. Call in your local Honeywell sales engineer . . . he's as near as your phone.

Flexible control assures precision in annealing

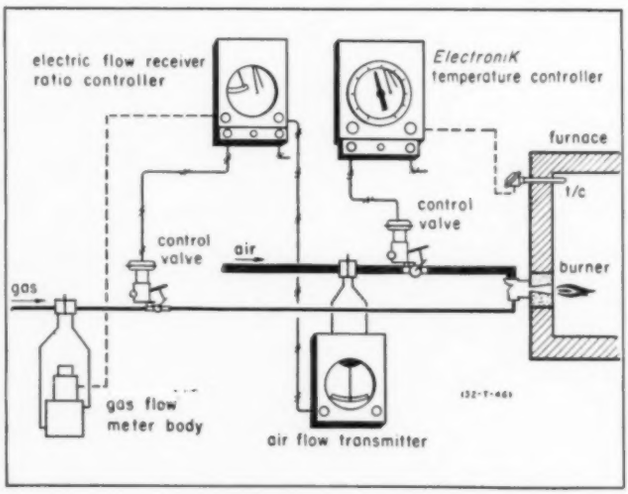
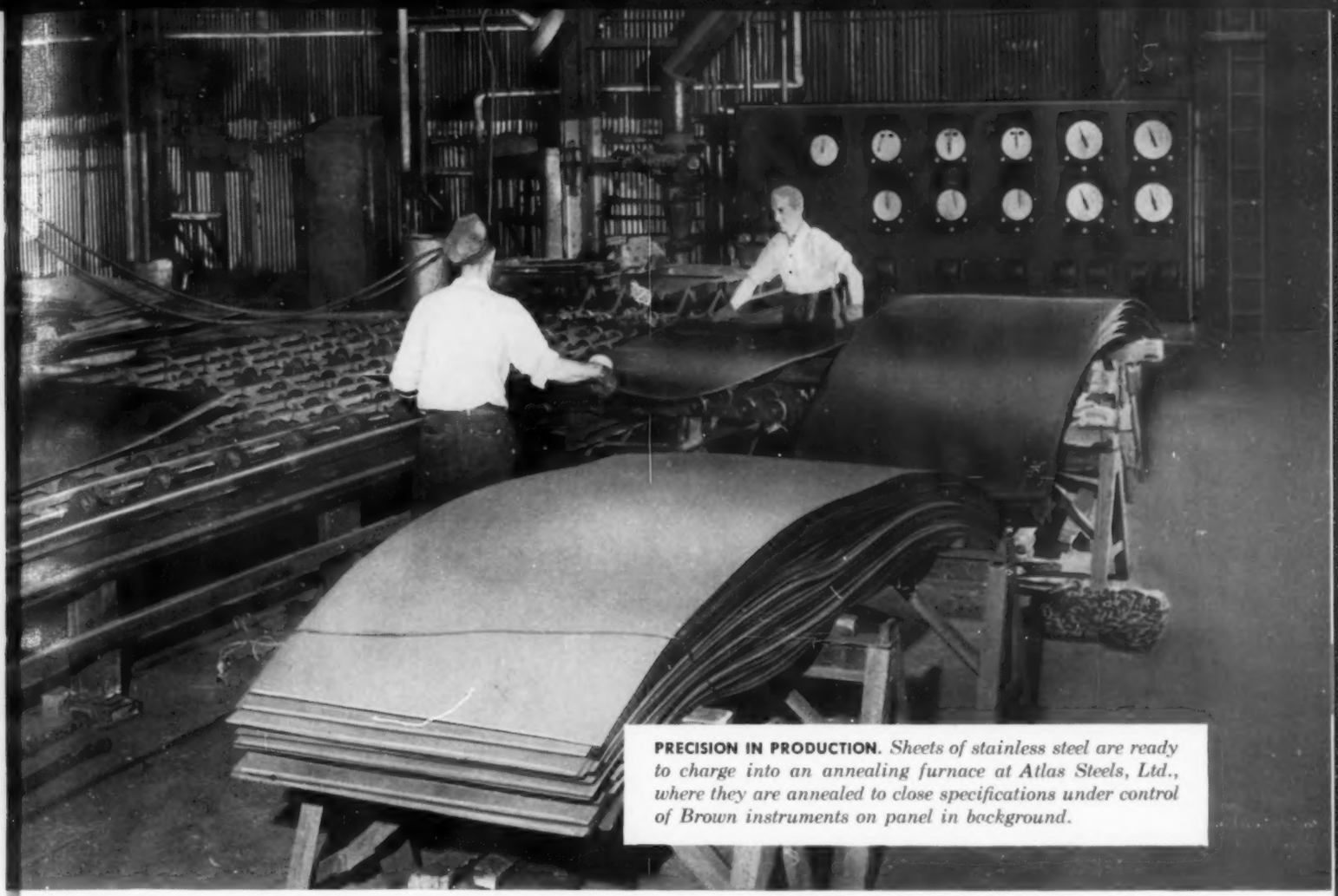


Diagram shows coordinated temperature and fuel-air ratio control system for one of the zones of the annealing furnace.



PRECISION IN PRODUCTION. *Sheets of stainless steel are ready to charge into an annealing furnace at Atlas Steels, Ltd., where they are annealed to close specifications under control of Brown instruments on panel in background.*

stainless sheet at Atlas Steels

ATLAS STEELS, LTD., one of the British Commonwealth of Nations' largest producers of quality steels, makes good use of modern Brown instrumentation in the production of many stainless, high speed and special purpose alloys. The accurate, flexible regulation of temperatures and fuel-air ratio obtained by custom-engineered control systems plays an important part in maintaining consistently high quality and economy.

A big sheet annealing furnace, for example, is equipped with coordinated control for each of four zones. Three zones are gas-fired, and the fourth is oil-fired. For each, a team of Brown instruments automatically holds furnace firing to exact specifications. An *ElectroniK* potentiometer, working with a platinum thermocouple, actuates the combustion air valve to hold constant temperatures. An air flow controller, using a bell-type meter body especially suited to low pressures, meters combustion air flow and resets the control index of a Brown flow ratio controller. This third instrument, in turn, regulates the gas or oil fuel valve . . . holding fuel-air ratio in accurate proportion at all firing rates.

The exact control thus obtained not only gives Atlas Steels the temperature precision essential to annealing of critical alloys, but also assures efficient utilization of fuel in this vital production operation.

Whether you're installing new furnaces or modernizing old ones, it will pay you to investigate the ways that Brown instrumentation can add to performance. Your nearby Honeywell sales engineer will be glad to discuss your specific problem . . . and he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

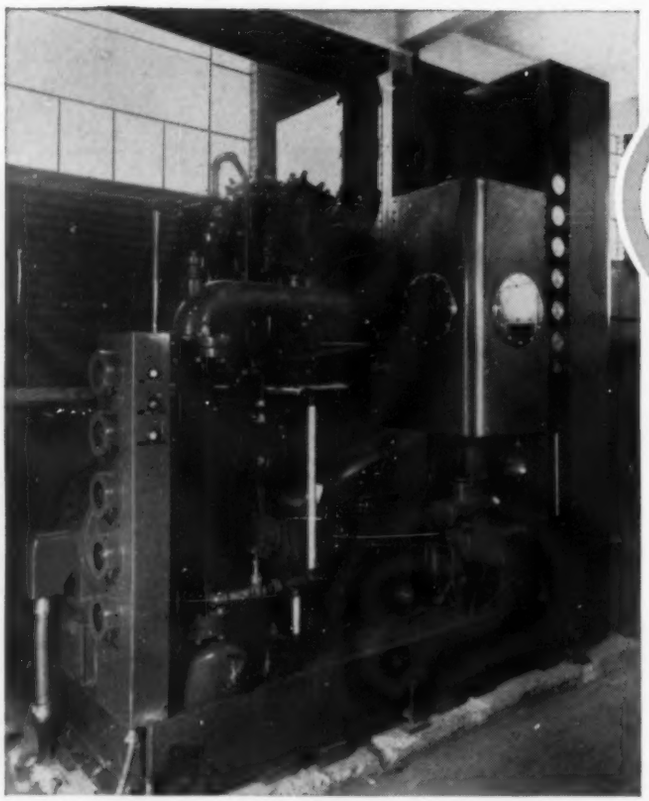
● **REFERENCE DATA:** Write for Catalog 1531, "*ElectroniK* Controllers," and for Data Sheet No. 4.3-4a, "Fuel-Air Ratio Controllers."

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

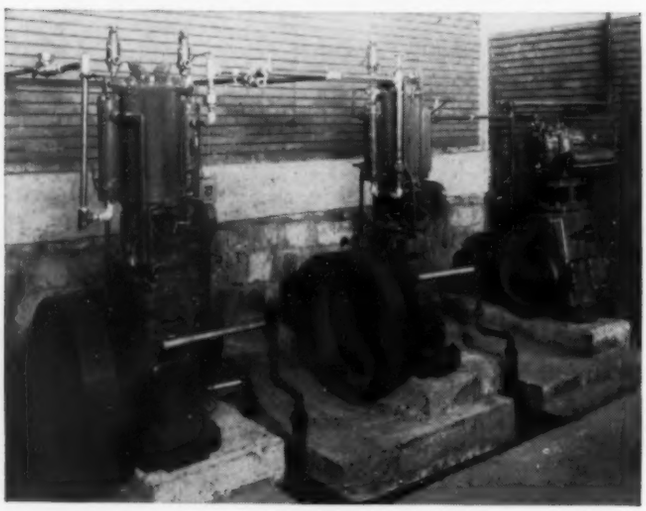
CUT YOUR OXYGEN BILL

by 67% with the

JOY OX-20 GENERATOR



OX-20 oxygen generating installation in the plant of a large metal working company.



Joy Oxygen Compressors used for boosting pressures of oxygen from the OX-20 Generator to pressures used in the line, storage system, and portable cylinders.

WITH a typical installation of the Joy OX-20 Oxygen Generator, you can reduce your total oxygen costs* to ONE-THIRD (or less) of the cost of purchased oxygen! *For example, if your average monthly oxygen usage is 1,000,000 cu. ft., your total oxygen-generating costs* would be about $0.11 per 100 cu. ft. The lowest available price for purchased high-purity oxygen in this quantity is about $0.35 per 100 cu. ft.*

The Joy high-purity oxygen generator is as reliable and easy to handle as an air compressor. It is absolutely safe and fully automatic in operation, with no bothersome chemicals to handle and store.

If *your* oxygen usage is between 600,000 and 4,000,000 cu. ft. per month, the Joy OX-20 is by far the most economical means of supplying your oxygen demand. ● Let us give you the facts and figures. **Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.** In Canada. *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

***Above costs include:**

Power (at $0.01 per KWH)
Water (at $0.10 per 100 cu. ft.)
Attendance Labor (at $2.00 per hour)
Maintenance (Labor and Parts)
Amortization (Ten-year Basis)

Consult a Joy Engineer

JOY

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885

W&D 15445

TIMKEN® bearings ended lubrication headaches on this hot mill 26 years ago

WHEN Wheeling Steel purchased this hot-strip mill in 1927, they specified Timken® tapered roller bearings for the roll necks on the work rolls and back-up rolls. These bearings have given extremely satisfactory service for the past 26 years while using economically applied, low-cost grease for bearing lubrication.

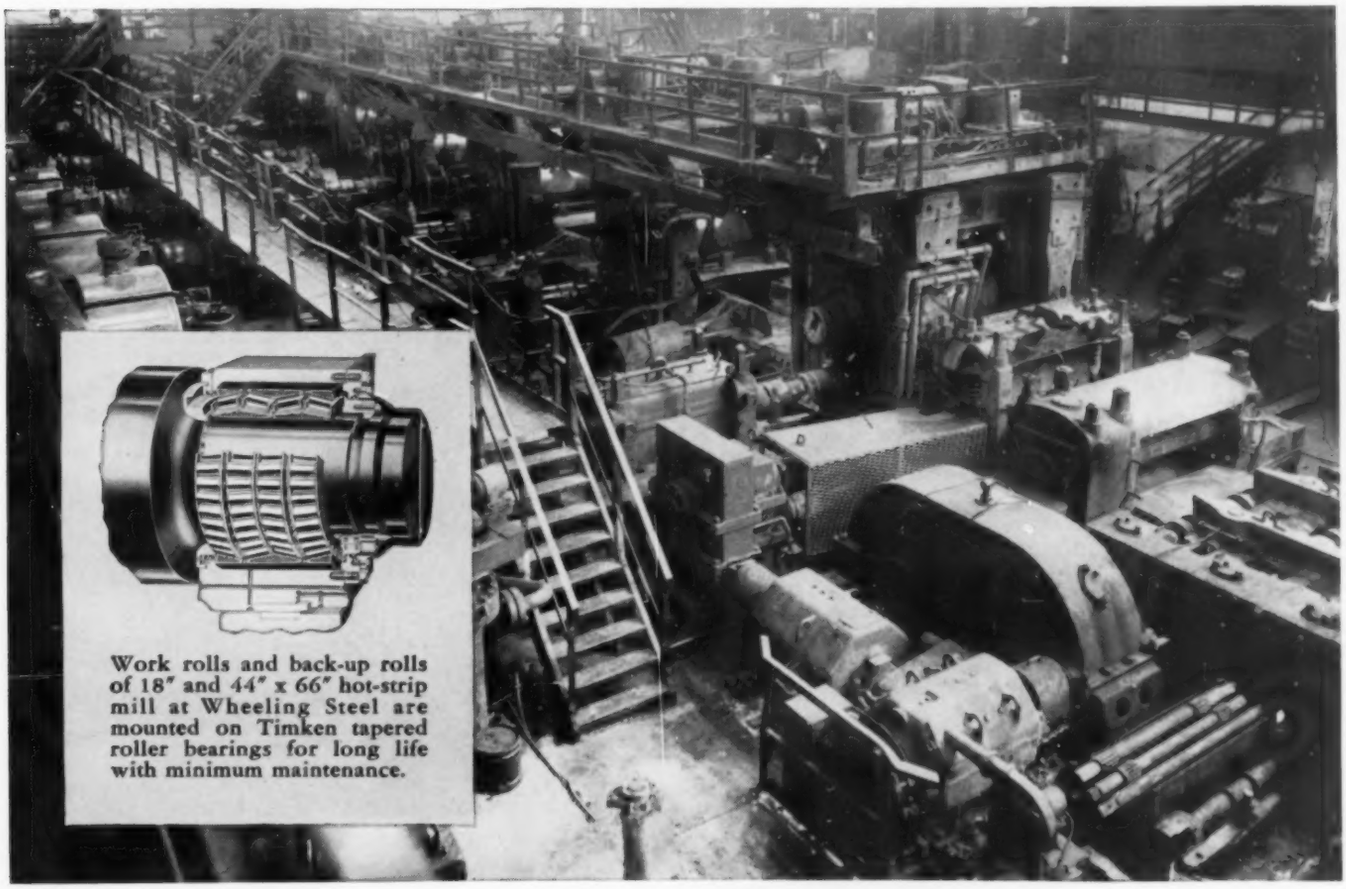
Their experience with grease-lubricated Timken bearings proves that there's no loss of lubricant during roll changes. Moreover, rolls can be changed in less time. And Timken bearings make closures more effective and reduce loss of lubricant because they keep the roll neck concentric with its chock.

Using Timken bearings will simplify mill designs all around. No special thrust units are needed because Timken bearings take both radial and thrust loads in any combination.

Timken bearings have exceptionally low frictional resistance—the result of true rolling motion based on proper geometric design and precision manufacture. This low friction reduces starting resistance and permits mills to accelerate more rapidly. Higher mill speeds are possible. Skidding or scuffing between work roll and back-up roll is reduced.

Timken bearings can be applied to machinery of any type to make it run better and last longer. Look for the trade-mark "Timken" on the bearings in the machines you buy or build. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

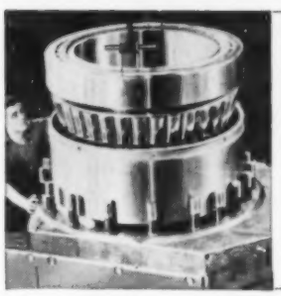


Work rolls and back-up rolls of 18" and 44" x 66" hot-strip mill at Wheeling Steel are mounted on Timken tapered roller bearings for long life with minimum maintenance.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



ROLL NECK BEARING ENGINEERING SERVICE

Our field and service engineers have had years of experience with problems of roll neck bearing design and operation. They'll help you select bearings and design mountings. The Timken Roller Bearing Company is the acknowledged leader in: 1. advanced design; 2. precision manufacture; 3. rigid quality control; 4. special analysis Timken steels.

NOT JUST A BALL ◯ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ◫ AND THRUST →◫← LOADS OR ANY COMBINATION ✳

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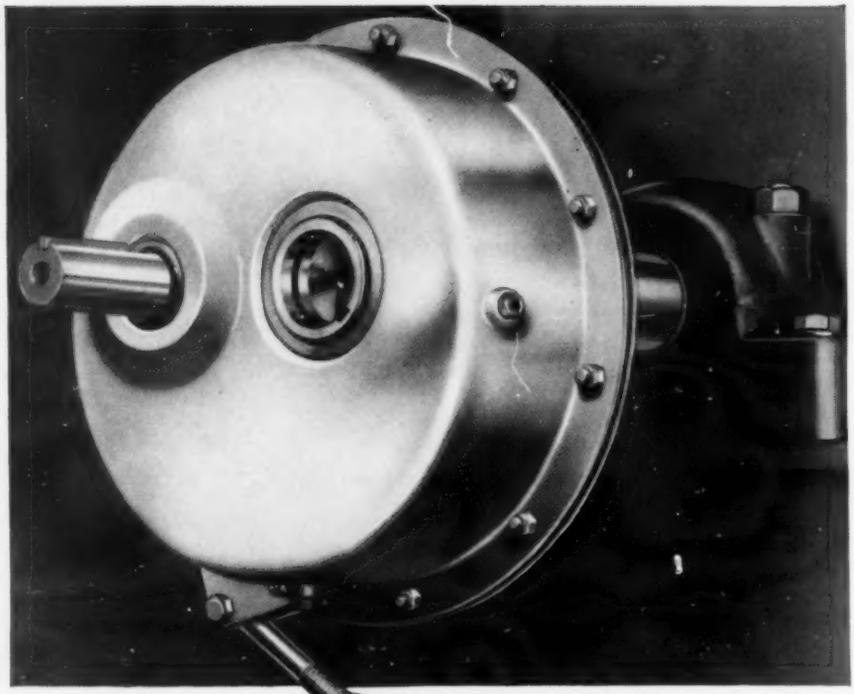

SIX SIZES

- 1/2 to 30 hp
- Single or double reduction
- Wide output speed range—420 to 10 rpm

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Shaft Mounted Drives—

simple-compact-rugged-efficient

Created specifically for the vast number of applications demanding a sturdy and compact speed-reducing unit for direct mounting on the driven shaft, the new Falk all-steel Shaft Mounted Drive is built to give long service life at substantial savings of space, time, power and maintenance costs!

This efficient helical-gear drive, latest in the unmatched list of Falk precision-gearing achievements is an ingenious modification of the time-tested Falk Motoreducer design which has held, for more than 20 years, recognized leadership in this branch of highest-quality power transmission . . . It complements and completes the world-famous Falk line of reduction units covering the entire range of industrial applications.

Investigate the Falk all-steel Shaft Mounted Drive. Write to Department 247 for engineering bulletin, including selection and dimension details.

THE FALK CORPORATION, Milwaukee 8, Wisconsin

MANUFACTURERS OF

- Motoreducers
- Speed Reducers
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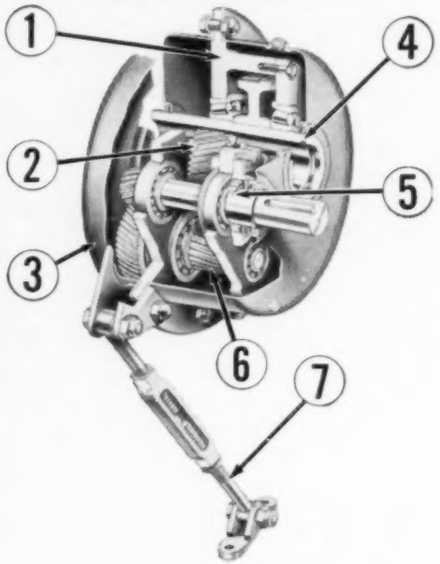
These famous FALK "In-built" factors *mean long life and dependability...*



1 **All-steel Frame,** with more than double the rigidity of iron, supports all rotating elements.

2 **Precision Helical Gears,** designed and machined by Falk, rated to AGMA standards.

3 **Pressed Steel Housings,** whose sole function is to keep oil in, dirt out; easily removed for gear inspection without dismounting unit.

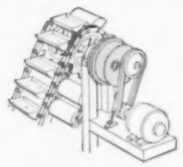
4 **Through Hollow Shaft** with counter bore provides for easiest installation or removal from driven machine shaft extensions.

5 **Backstop** can be furnished with the unit or added later for positive prevention of reverse rotation.

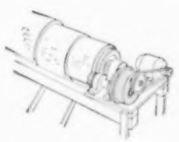
6 **Positive Lubrication,** continuous direct dip of revolving elements at all speeds.

7 **Tie Rod** and turnbuckle serve as anchor and facilitate V-belt or chain adjustment.

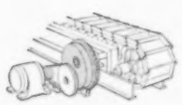
A FEW TYPICAL APPLICATIONS



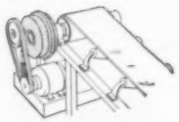
BUCKET ELEVATOR



SAND CLASSIFIER



APRON FEEDER



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Designers and Builders of Ferrous and Non-Ferrous Rolling Mills, Mill Rolls, Auxiliary Mill and Processing Equipment, Presses and other heavy machinery. Manufacturers of Iron, Nodular Iron and Steel Castings and Weldments.

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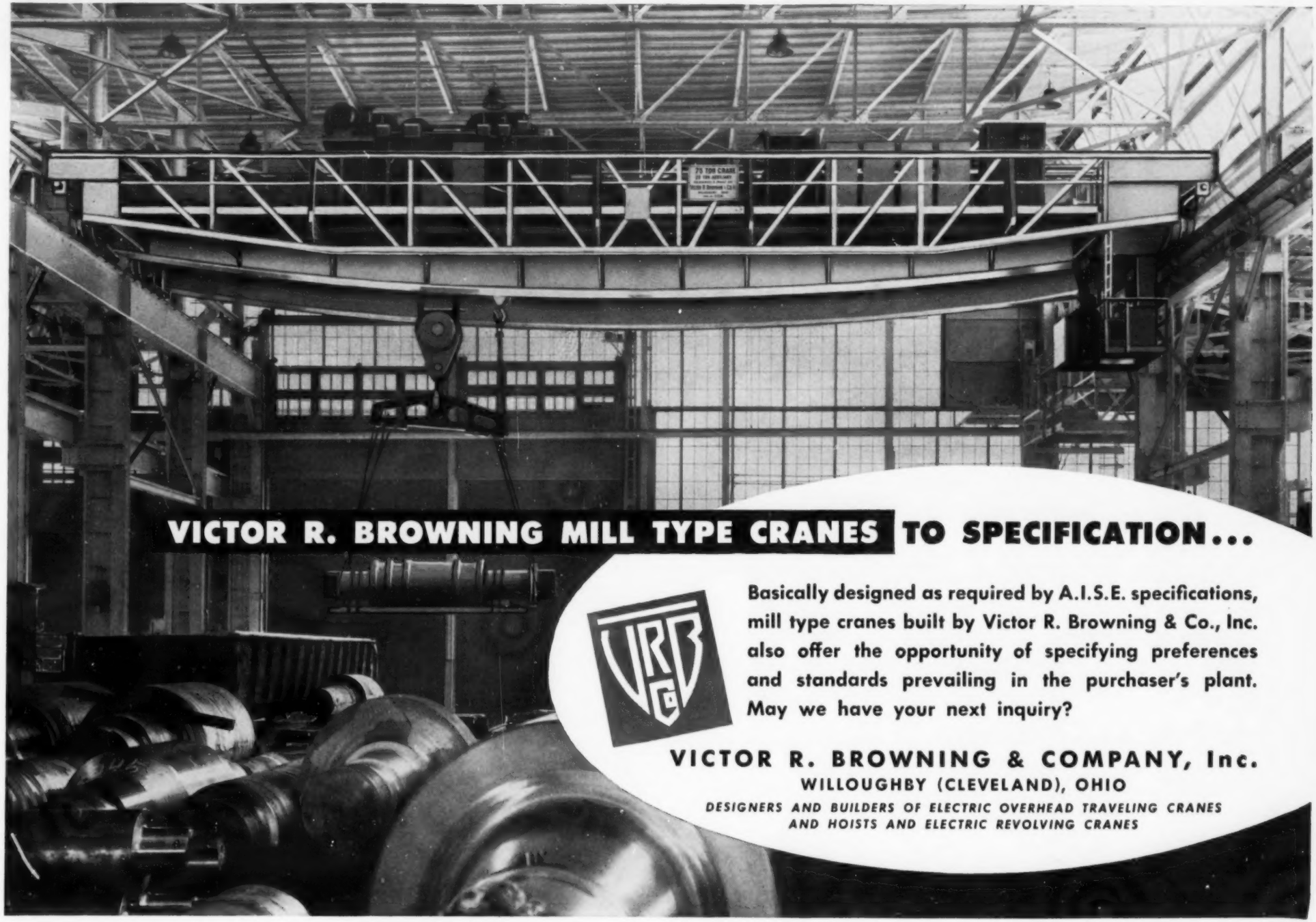


VICTOR R. BROWNING MILL TYPE CRANES TO SPECIFICATION...

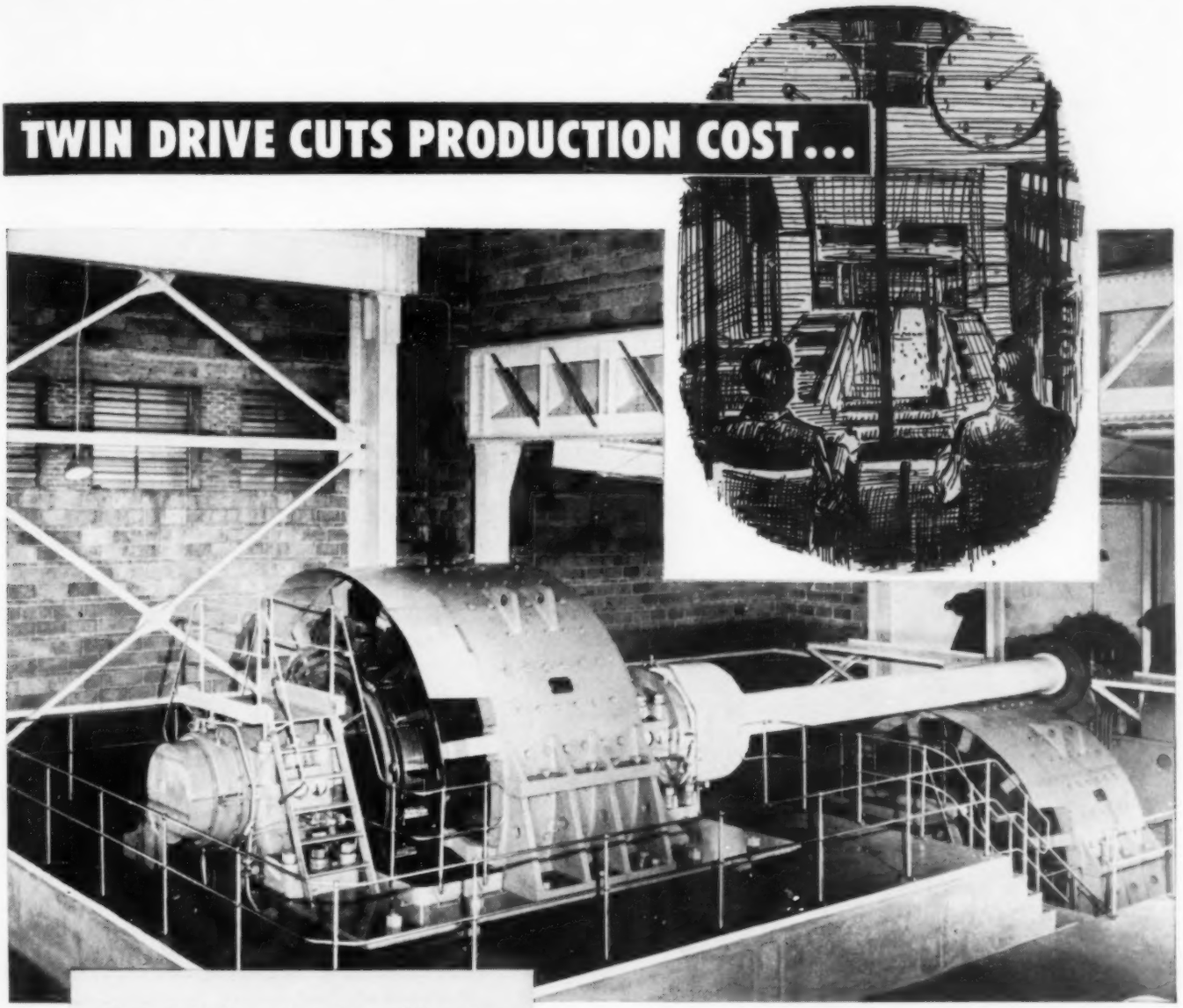
Basically designed as required by A.I.S.E. specifications, mill type cranes built by Victor R. Browning & Co., Inc. also offer the opportunity of specifying preferences and standards prevailing in the purchaser's plant. May we have your next inquiry?

VICTOR R. BROWNING & COMPANY, Inc.

WILLOUGHBY (CLEVELAND), OHIO

DESIGNERS AND BUILDERS OF ELECTRIC OVERHEAD TRAVELING CRANES AND HOISTS AND ELECTRIC REVOLVING CRANES

TWIN DRIVE CUTS PRODUCTION COST...



Canada's first twin drive blooming mill is cutting production costs for Dominion Iron & Steel Limited, a subsidiary of DOSCO.

The twin drive, where each work roll has its own motor —

- **eliminates pinion housing and saves an energy loss of approximately 4 to 5%**
- **cuts out pinion lubrication and maintenance costs**
- **cuts reversing peak current by reduced motor inertia**
- **reduces roll wear by cutting out slip due to different roll diameters**
- **provides increased rolling efficiency**

Each motor in this installation at Dosco's Sydney plant develops a peak of 10,500 H.P.; together give a total of 21,000 H.P.

PA5409

For thirty years, English Electric have built drives for hot and cold rolling mills of every kind and the value of this experience is yours for the asking. If you have a mill drive problem, whether it be power supply, substation, cabling, ventilating or complete layouts, give us a call. Our publication MT/108 describing the rolling mill twin drive is available on request.

ENGLISH ELECTRIC

Vancouver, Calgary, Winnipeg, Toronto, Ottawa, Montreal and Halifax.
English Electric Company of Canada Limited, St. Catharines, Ontario.

Know the Facts!

ON EC&M TAB-WELD RESISTORS

✓ EASILY APPLIED

Assembled in standard mill sections, EC&M TAB-WELD Plate Resistors are convenient to apply and use. Several tap-plates are provided to make external connections easy and permit a choice of adjustments. These same advantages reduce down-time when old existing sections are replaced with TAB-WELD Resistors.

✓ LESS MAINTENANCE

Preventive maintenance is reduced with EC&M TAB-WELD Resistors because periodic tightening of end clamping-nuts and bolts is eliminated. Spot welding joins offset resistor ends to assure a permanent current carrying path. There is no burning at tap-plates or grid-eyes.

✓ LONGER LIFE

EC&M TAB-WELD Resistors, constructed of corrosion-resistant steel, are non-breakable. They are available in capacities up to 150 amperes without internal paralleling. For larger capacity, complete sections can be readily paralleled from the external tap-plates.

SPECIFY EC&M TAB-WELD RESISTORS

Write for Bulletin 942-B

THE ELECTRIC CONTROLLER & MFG. CO.

2698 E. 79TH STREET • CLEVELAND 4, OHIO

Patent Reviews

By MELVIN NORD
Patent Attorney
Detroit, Mich.

. . . . copies of patents may be obtained from the Commissioner of Patents, Washington 25, D. C., at 25 cents each . . . . patents reviewed cover period September 7, 1954 through September 28, 1954. . . .

CONTINUOUS HEATING FURNACE

▲ U. S. 2,689,119, issued Sept. 14, 1954 to James W. Percy and assigned to United States Steel Corp., describes a two-zone furnace for continuous heating of articles such as billets, blooms, or slabs.

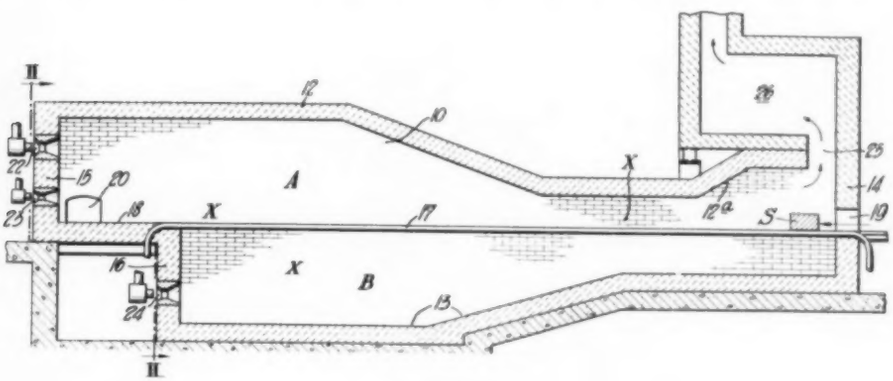


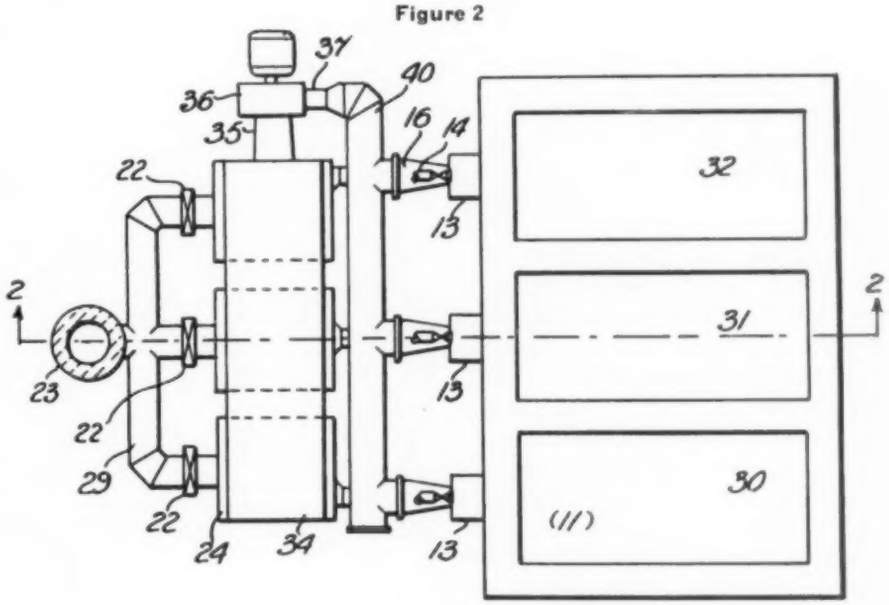
Figure 1

The furnace is shown in Figure 1. The entry wall 14 has an opening 19 through which articles S, such as billets, blooms or slabs, are introduced to the skids 17 for heating. After traveling the length of the skids and hearth, where they are heated to an appropriate temperature for hot working, the articles are pushed from the furnace through an opening 20 in one of the side walls.

The furnace has only two heating zones A and B, the former above the hearth and skids and the latter below the skids. Zone A is equipped with a row of main top burners 22 and a row of smaller auxiliary burners 23 below the main burners. Zone B is equipped with a row of main bottom burners 24 in the lower wall. The products of combustion from both zones discharge through flues 25. The furnace is equipped with a recuperator 26.

In operation, the furnace can be fired using either (a) the main bottom burners 24 and main top burners 22, (b) the main bottom burners 24 and auxiliary top burners 23, or (c) all three sets of burners. The first mode of firing is for normal rates of operation, the second for substantially lower rates, and the third for substantially higher rates. In addition, the auxiliary burners 23 can be used as mill delay burners to hold the furnace at proper temperature during shutdowns. Preferably the furnace has at least three temperature control points which are located as indicated at X and at which the usual

Figure 2



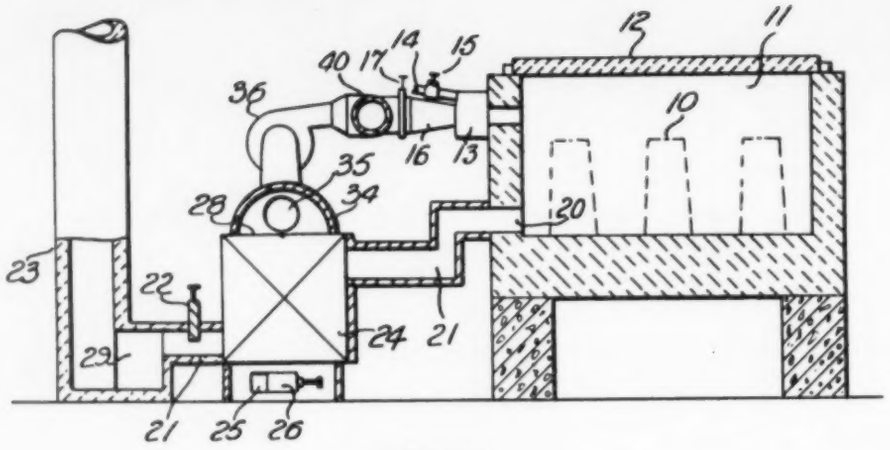


Figure 3

automatic temperature controls are connected. Such an arrangement assures proper heating at any operating rate from a few tons per hour to more than 150 tons per hour and automatically takes care of firing the furnace during mill delays. Such a burner arrangement offers the advantage of operating flexibility and in addition shortens the hearth length for a furnace of any given capacity.

HEATING APPARATUS FOR SOAKING PITS

In U. S. 2,689,722, the recuperators of a battery of soaking pit furnaces are coordinated in such a way that a chamber containing relatively cold work may receive hotter air for combustion than it would ordinarily receive from its own recuperator during the initial heating of the work. The patent was issued Sept. 21, 1954 to Philip L. Knight and assigned to Surface Combustion Corp.

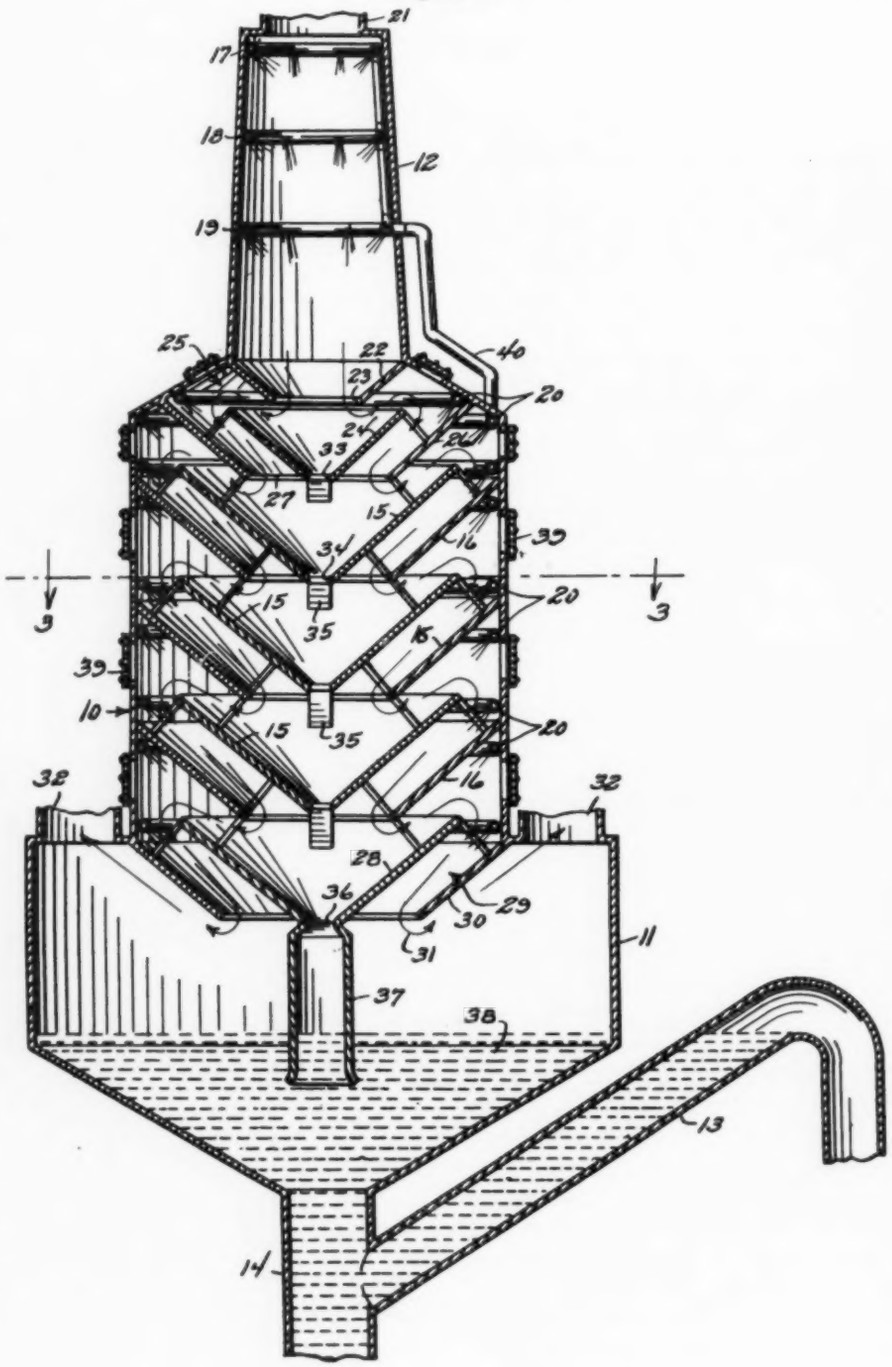
In Figures 2 and 3, steel ingots are heated in a vertical chamber 11 which is normally closed by a removable cover. Three of such chambers are shown, each with its own burner 13 supplied with fuel through a pipe 14 and with air for combustion through a duct 16.

Flue gas is exhausted through a port 20 leading to the stack 23. A recuperator 24 takes heat from the exhaust gas and transfers it to the combustion air, which enters through duct 25. The heated air from each of the recuperators flows into a common air collecting header 34. The air is then blown by fan 36 into an air distributing manifold 40 and then to the burners. Thus, all combustion chambers receive combustion air at the same temperature at any given time. This permits more rapid heating of relatively cold work. Also, only a single fan is required instead of one for each chamber.

BLAST FURNACE GAS WASHER

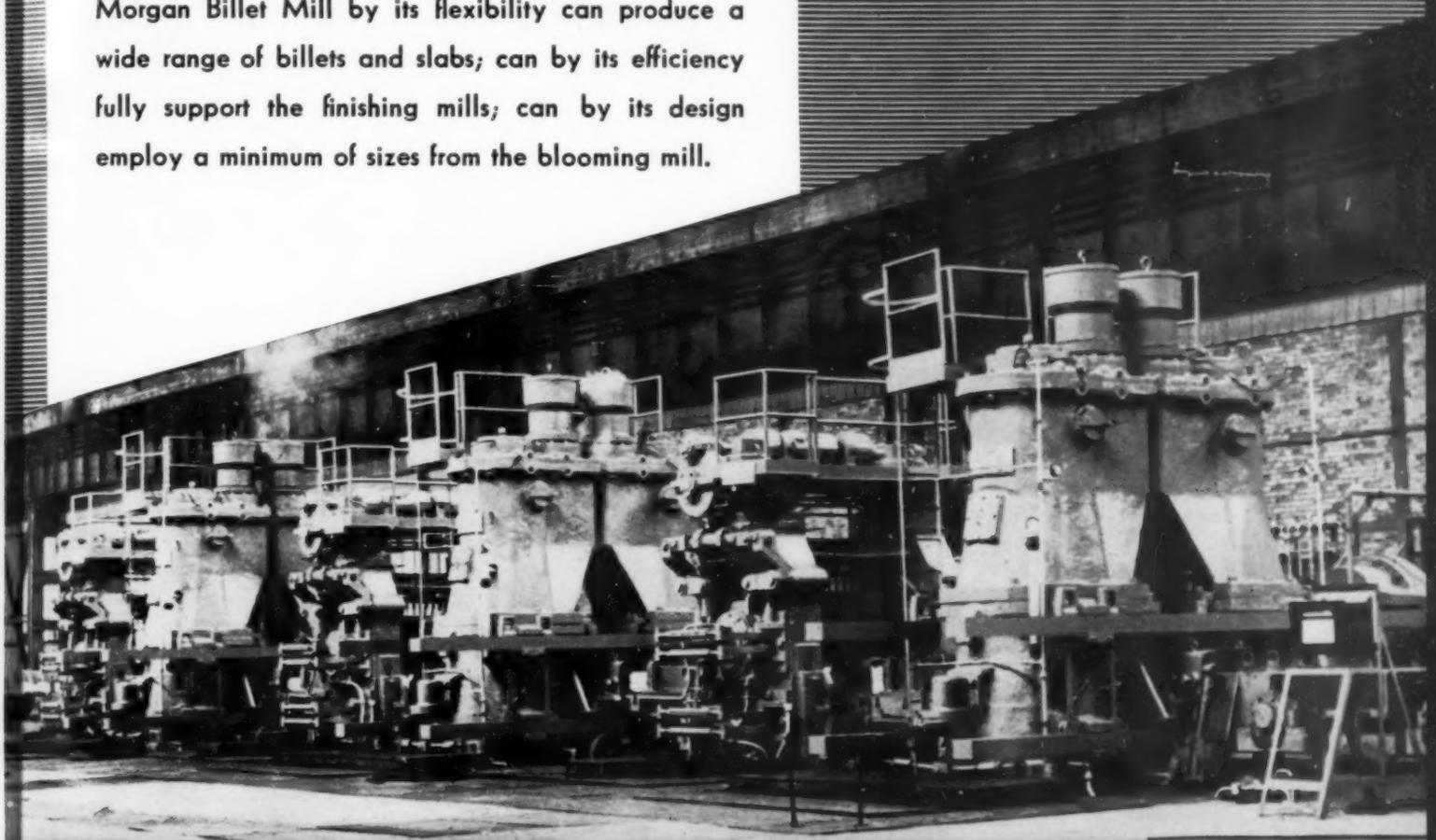
U. S. 2,689,715, issued Sept. 21, 1954 to Paul Ericson, describes a washer for blast furnace gases. In Figure 4, gas enters at the top inlet 21 and then passes into a conical shaped baffle 24, then up and out to the area 25, then inward along the upper surface of baffle 26 and through

Figure 4

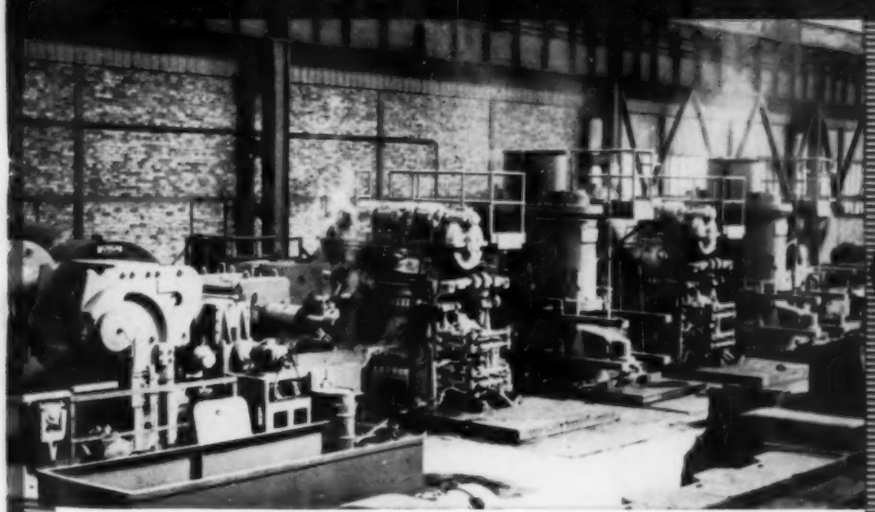


Is Your BILLET MILL *the weak link?*

Rod, Merchant, Narrow Strip, and Skelp Mills all depend on the Billet Mill for steel — a Modern Morgan Billet Mill by its flexibility can produce a wide range of billets and slabs; can by its efficiency fully support the finishing mills; can by its design employ a minimum of sizes from the blooming mill.



At Consett Iron Works, Durham, England, a 6-Stand 30" Vertical-Horizontal Mill finishes larger sizes and also rolls Process Sections for



a 4-Stand 24" Vertical-Horizontal Mill which finishes the small sizes. A Morgan Electric Flying Shear divides the billets and slabs to accurate lengths . . .

RM-65

MORGAN CONSTRUCTION CO.

WORCESTER, MASSACHUSETTS

English Rep., International Construction Co., 56 Kingsway, London W. C. 2, Eng.

MORGAN
WORCESTER

ROLLING MILLS - MORGOIL BEARINGS
WIRE MILLS - GAS PRODUCERS - AIR EJECTORS
REGENERATIVE FURNACE CONTROL

the opening 27. The gas then passes around a number of similar baffles and finally out the discharge connection 32. A number of water spray nozzles 17, 18, 19, 20 wash the gas. The water overflows through the small openings 33, 34, 35, and 36, and leaves through the leg 13.

APPARATUS FOR REDUCING SMELTING IRON ORE AND GENERATING POWER

U. S. 2,688,478, issued Sept. 7, 1954 to Henry G. Lykken, Minneapolis, Minn., describes an apparatus for reducing-smelting finely divided iron ore and simultaneously producing carbon monoxide gas and power. In utilizing finely-divided ores or concentrates, it has been necessary to produce ore agglomerates by sintering together the relatively fine particles into larger masses of sufficient strength, porosity and size so as to permit their use in the ordinary blast furnace. Such sintering and agglomerating processes require heat and power, and hence in order to use finely-divided ores it has been necessary to charge against such ores the cost not only of any beneficiation which may be carried out on the ore, but also the cost of agglomerating, briquetting and sintering. The present invention avoids the necessity of agglomerating the ore.

The apparatus is shown in Figure 5. The furnace is of rectangular cross-section, and has a relatively large combustion space above the hearth. The base 10 is provided with a raised central portion 11 and is sloped off to the ends 12 and 13, and at each end is provided with a tap opening, as at 14 and 15, for drawing off the smelted metal. The slag tap openings 16 and 17 are arranged slightly spaced from the metal tap openings and at a more elevated position in the hearth wall. Above the hearth the end walls 18 and 19 and the side walls 20 and 21 rise to a distance approximately three and one-half to four times the width of the hearth. These walls are provided with heat absorbing, steam generating boiler tubes at 22, 23, 24, and 25. At the base of the hearth there are provided headers 26 and 27, to which the banks of tubes 22 and 23, respectively, are connected at their lower end. Similarly, at the ends of the hearth there are provided headers 28 and 29 to which the banks of tubes 24 and 25, respectively are attached. The hearth walls 20 and 21 terminate at the level 30 and above this level the tubes 22 and 23 continue exposed and at their upper ends are slanted in at 31 and 32 where they are connected to the steam

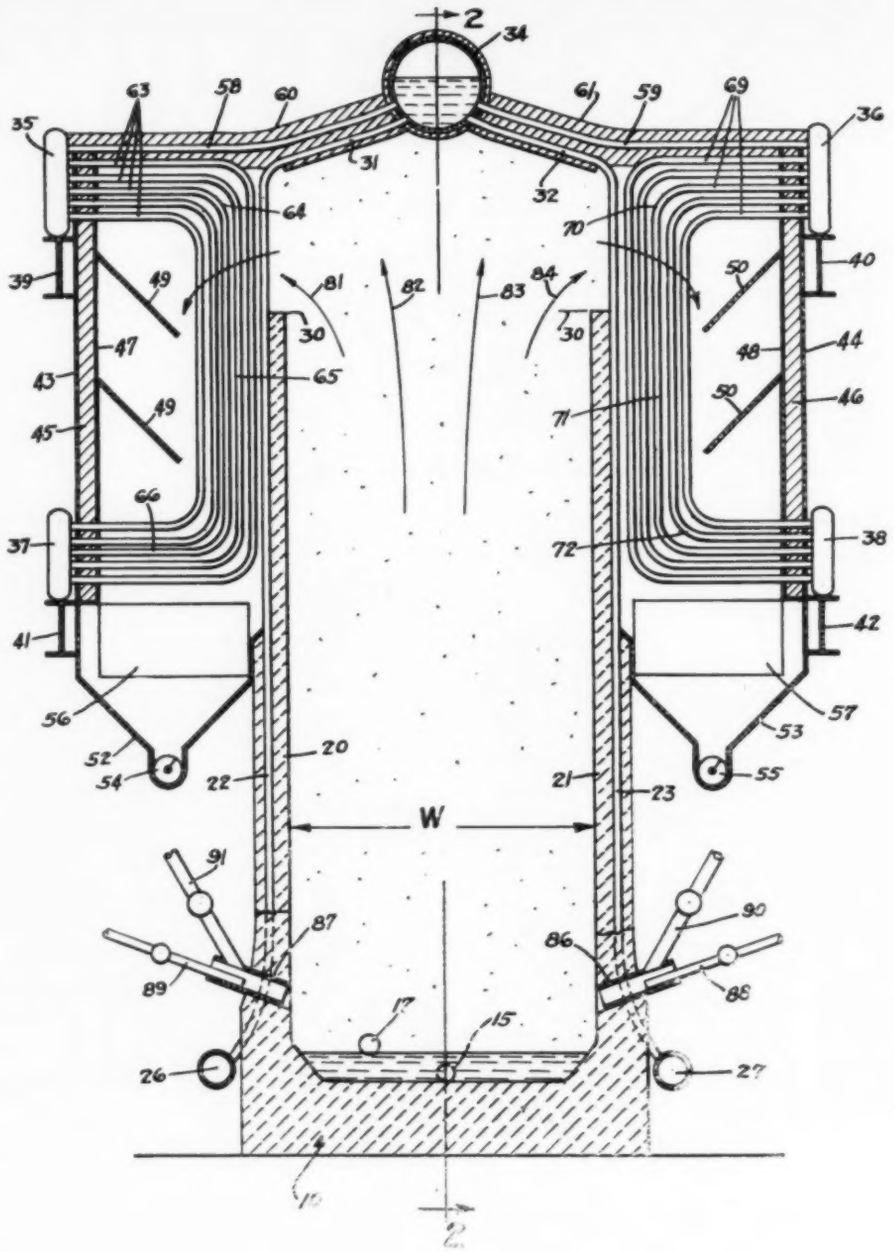


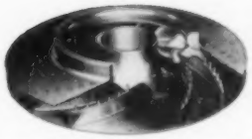
Figure 5

OTHER PATENTS OF INTEREST TO THE IRON AND STEEL ENGINEER

Patent No.	Date	Subject	Inventor or Assignee
2,688,573	9/ 7/54	Heat-treating magnetic iron to restore its magnetic properties	Western Electric Co., Inc.
2,688,956	9/14/54	Skewback structural shape for open-hearth furnaces	Blaw-Knox Co.
2,689,177	9/14/54	Corrosion-resistant alloy steels	The A.P.V. Co., Ltd.
2,689,990	9/28/54	Method of casting a white cast iron pipe	United States Pipe & Foundry Co.
2,690,259	9/28/54	Froth flotation of iron sulfide ore	Bethlehem Steel Co.
2,690,333	9/28/54	Apparatus for smelting iron and other oxide ores	Edmund S. Pomykala
2,690,390	9/28/54	Method of reducing iron ore	Combustion Processes Co.
2,690,392	9/28/54	Producing improved gray cast iron	International Nickel Co., Inc.

ALLIS-CHALMERS

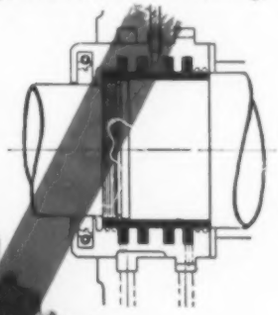
Multi-Stage Centrifugal Blowers

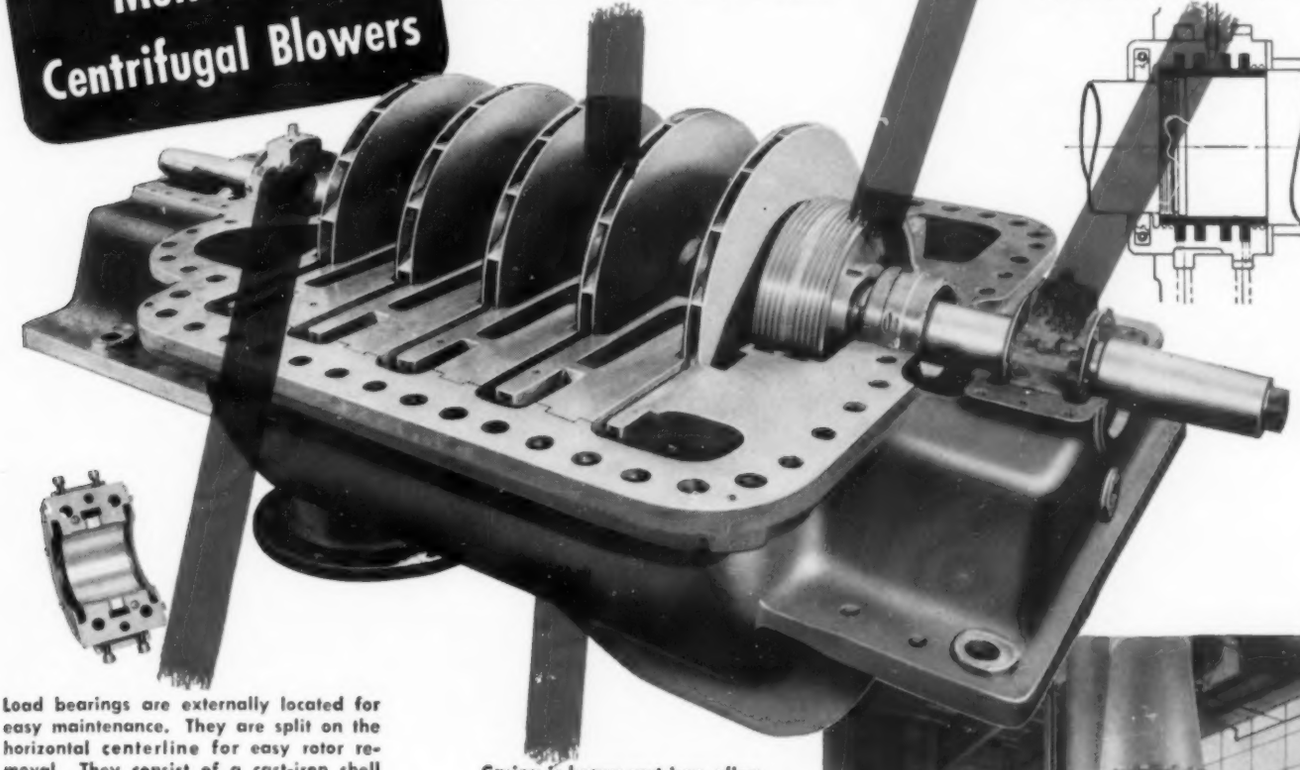


Impeller construction provides unobstructed passage of air or gas. Impellers are furnished in riveted or welded types, as determined by impeller dimension. Note that in riveted impeller wheels, rivets are integral with, and milled from, blade stock.

Impeller wheels are located accurately on shaft with sleeves and are mounted with light shrink fit. Bores are ground to size. Lock nuts prevent axial movement.

Sealing during operation is provided by oil pressure seals. A carbon ring seal prevents leakage when blower is not running.





Load bearings are externally located for easy maintenance. They are split on the horizontal centerline for easy rotor removal. They consist of a cast-iron shell with removable, babbit-lined steel inserts.

Casing is heavy cast iron, alloy, or forged steel.

Why these blowers can run for years *without stopping*

The key to "round the clock" performance is *quality*, as illustrated in the features above.

For highly dependable, low maintenance air and gas handling equipment, as well as motors and control, call your nearby Allis-Chalmers office, or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4530

This Allis-Chalmers four-stage centrifugal blower supplies 24,000 cfm to the catalytic cracking tower of an eastern refinery on a 24-hour-a-day basis, month in and month out.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

FARRELL -CHEEK

One Point Service

The above gears, wheels, and sheaves complete with bushings, bearings, keyways, and finish machining were part of a single shipment to a user of highest quality carbon and alloy steel castings.

ONE SOURCE FOR EVERY ALLOY AND CARBON STEEL CASTING NEED

FARRELL-CHEEK HIGH-PERFORMANCE CASTINGS OFFER YOU SAVINGS IN COST, MAINTENANCE, AND "DOWN TIME."

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HEAVY HARDWARE
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YOUR INQUIRY WILL PROMPTLY BRING DETAILED INFORMATION PERTAINING TO ANY OF THE ABOVE FARRELL-CHEEK PRODUCTS

SANDUSKY, OHIO

drum 34. The upper part of the hearth is in the form of a water tube boiler. The walls 43 and 44 extend downwardly and form dust-collecting hoppers at 52 and 53, these hoppers being provided with worm screws 54 and 55, by means of which dust collected in the hoppers is withdrawn. At the ends of the hoppers are openings 56 and 57 which lead to stack breechings for drawing off the gases produced in the hearth.

In the lower side walls 20-21 of the hearth there are set a number of tuyeres 86 and 87, these tuyeres being set at an angle so that the combustible gas blast entering into the hearth through the tuyeres blasts downwardly on the bath of molten metal and slag in the bottom of the hearth. The tuyeres 86 and 87 are distributed along the walls of the furnace so as to provide an even introduction of fuel, ore and finely-divided flux. Each tuyere is provided with an air or oxygen inlet as at 88 for tuyeres 86, and 89 for tuyeres 87. Into the tuyere tubes 86 and 87 there is also provided an inlet channel 90 for tuyeres 86, and 91 for tuyeres 87, through which finely-divided ore, lignite char (as fuel), and flux is introduced. The amount of oxygen introduced is in the exact proportion to maintain a carbon monoxide atmosphere throughout the furnace. Adequate carbon and oxygen is used with the ore to maintain a temperature in excess of 2700 F to effect reduction and melting of the ore and gangue above and at the surface of the bath. In the event carbon is absorbed in the molten iron at the base of the hearth, additional iron oxide may be introduced so as to reduce the carbon content, or the oxygen that is introduced into the furnace may be increased so as to burn out part of the carbon. The metal and the slag produced in the hearth is withdrawn from time to time as in the standard blast furnace.

Based upon a 60 per cent iron content as iron magnetite, a total of 2344 pounds of carbon is indicated for each 2000 pounds of metallic iron. Of this amount of fuel, only 340 pounds or approximately 23 per cent is required for reducing and smelting the ore. The bulk of the fuel introduced, (about 1800 lb or 77 per cent) less radiation and other heat losses, appears as recoverable heat, largely as carbon monoxide gas. Thus, with such proportions of ingredients, approximately 3400 lb of carbon monoxide gas having a heat value of upwards of 24,000,000 Btu and containing approximately 2,200,000 Btu sensible heat is produced, the sensible heat being recovered in the steam generator portion of the furnace.

SPARK ARRESTER AND SMOKE SUPPRESSOR FOR CUPOLAS

A number of water sprays in series are used to arrest sparks and suppress smoke from cupolas in U. S. 2,688,943. The patent was issued Sept. 14, 1954 to Algot A. Wickland, Chicago, Ill.

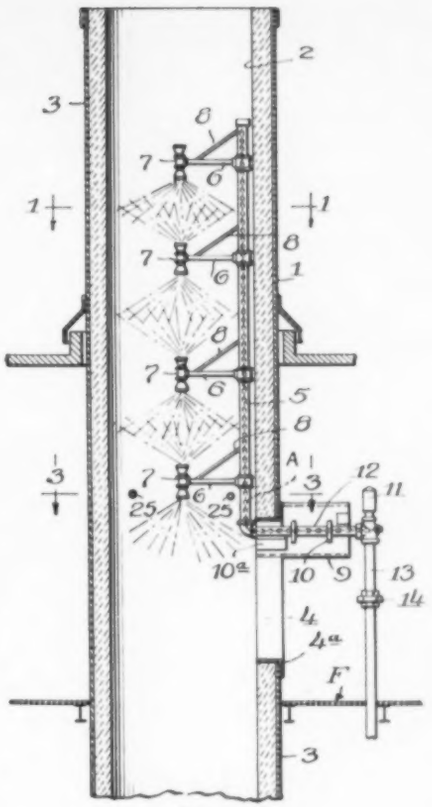

Figure 6

As shown in Figure 8, a number of water sprays 7 are placed in the stack. A chain A is inserted in the riser 5 to prevent its falling down in the event of weakening of the assembly under excessive temperatures caused by a water failure.

The flow of water to the sprays is controlled by thermostats 25 in the stack.

There is a demand for copies of the following Yearly Proceedings:

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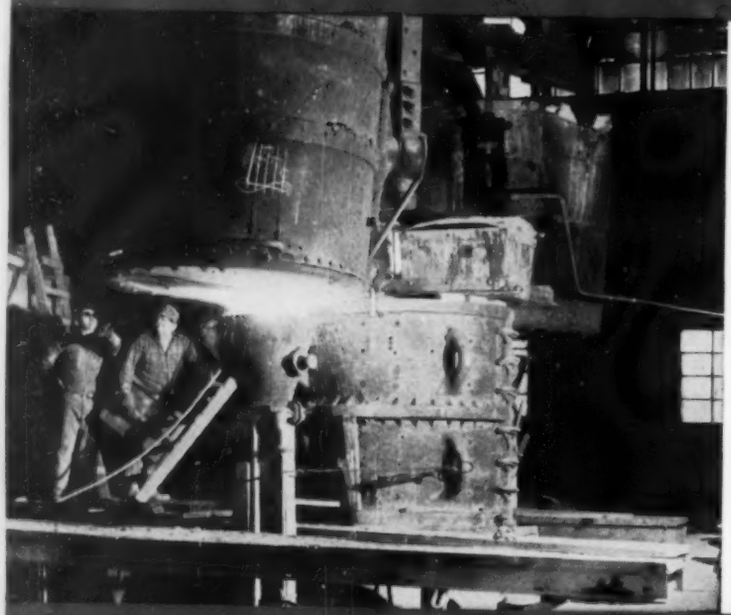
1 FACILITIES—complete modern shop facilities to make Pittsburgh Rolls individually tailored for each application.



4 POURING—close time and temperature control to assure sound castings.

5 HEAT TREATING—most modern methods used to provide proper strength and hardness.

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7 TURNING AND MACHINING—accurately done to close tolerances.

2 SPECIFICATIONS—strict adherence to specification and analyses

3 CUSTOM MOULDING—only finest foundry materials and workmanship go into each mould

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"The right roll in the right stand"

Recent technological improvements . . . combined with 80 years know-how in roll making . . . assure you of quality rolls for every type of application.

Engineering, design and application service . . . provided by engineers with years of practical experience . . . assure you of "the right roll in the right stand" to produce more tonnage with less down time.

Rolls are color marked for specific applications

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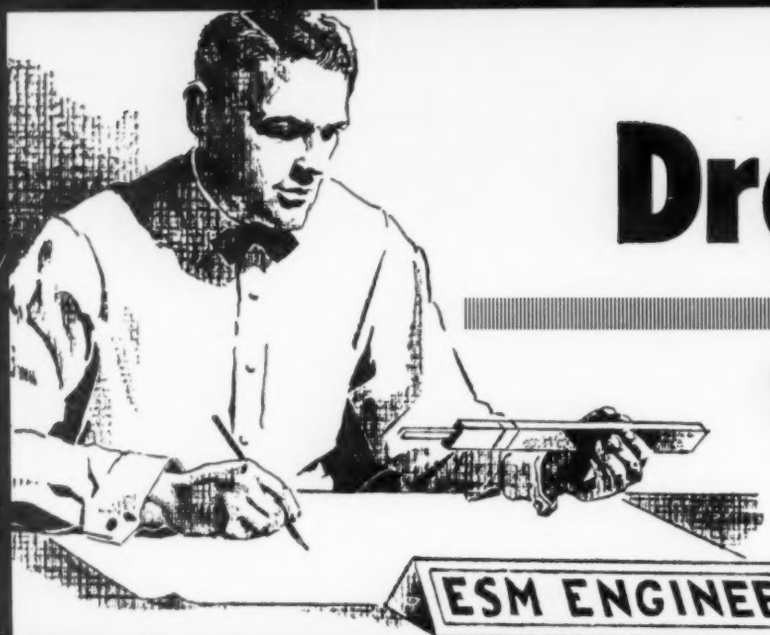

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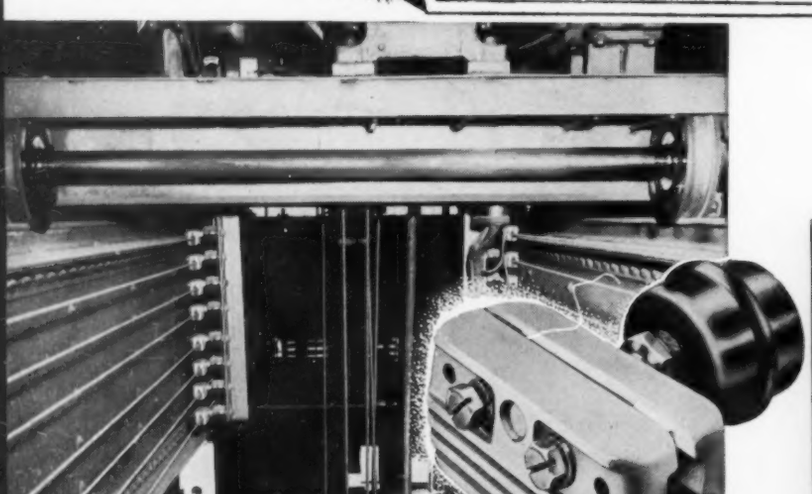
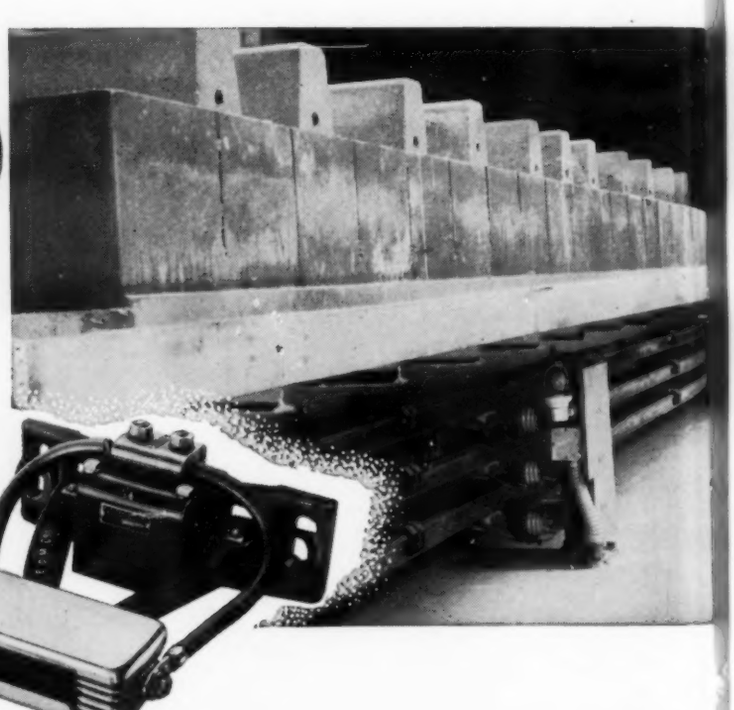
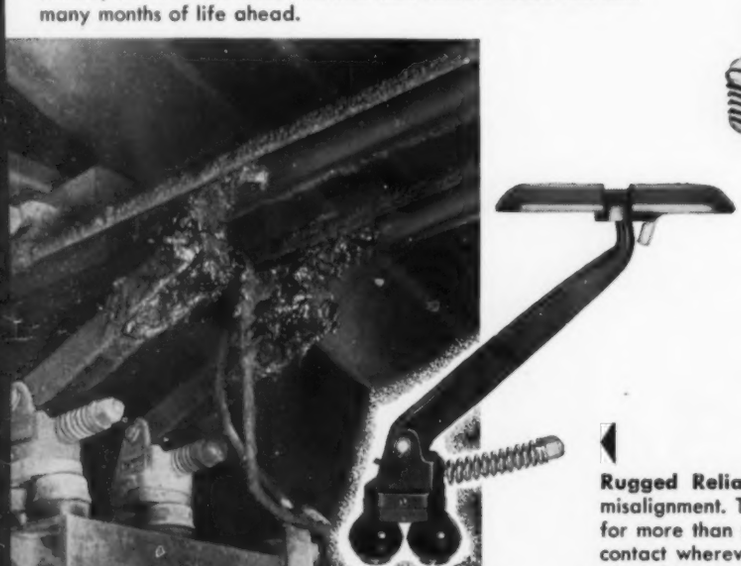


More Usage, Less Wear for Keystone XVI Crane Trolley Collectors. Installed on an overhead crane the same day wheel-type collectors went on a similar crane, they were in operation 50% longer each day. When wheels were removed due to failure, the XVI renewable carbon shoe contact inserts still had many months of life ahead.



Long, Hard, Hot Service at Birdsboro Steel Foundry & Machine Co. Loaded furnace cars move in and out of heat treating furnaces safely and without a hitch. Rails on each furnace car contact stationary columns equipped with Keystone LMI Pony-size Contact Rail Collectors. These reversible collectors offer 30% greater contact travel, efficient current transfer.



Rugged Reliability in the face of dirt, rainy and icy conditions, and severe misalignment. These Keystone Inverted-V Universal Collectors have operated for more than seven years at the Alan Wood Steel plant. They give positive contact wherever the going is rough, tough, and dirty—in open hearth, coke plant, blast furnace.

ELECTRIC SERVICE MANUFACTURING CO.,

third-rail

problems on his desk!

Engineer will collaborate and . . .

Keystone Conductor System (Steel, Aluminum or Copper)

your Present System for Greater Efficiency and Economy

Suitable ESM Equipment for the Job

INDUSTRIES rely heavily on the Electric Service engineer for designing or converting power Conductor Systems. There are three main reasons:

ESM ALUMINUM, STEEL, COPPER SYSTEMS—All three are designed and built by Electric Service. Each has its proper applications, resultant economies. The system specific to *your* needs is recommended without bias.

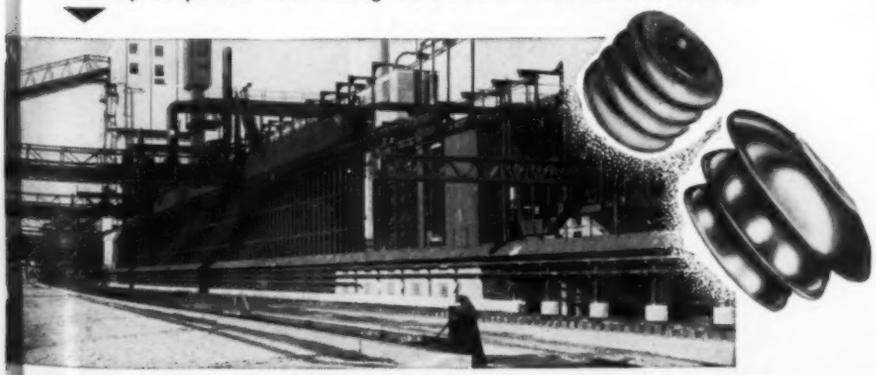
ESM SERVICE IS COMPLETE—Engineering counsel is backed up by the complete line of Keystone Equipment and by ESM installation specialists. Electric Service engineers new systems, modernizes inadequate systems, repairs existing systems.

ESM PRODUCTS ARE JOB-PROVED—They're at work on all types of materials handling equipment in every industry—steel mills, power plants, docks, rail yards, processing plants. Typical installations shown here illustrate the scope and reputation of Electric Service in this electrical power-transmission field.

What's your problem?—insufficient power? . . . severe weather or corrosion conditions? . . . production-sapping shutdowns? . . . excessive maintenance? Write today for assistance.

Aluminum Reduces Corrosion, cuts deadweight for Canton Co. Baltimore Harbor's salty dampness doesn't faze Keystone Integrated Aluminum Conductor System. High-speed ore unloader utilizes aluminum on trolley conductors and on 1200-ft., 2300-volt main runway. Aluminum Under-running System has high current capacity, low voltage drop, sensitive control.

Unhurt by Volts, Jolts are the Keystone Insulators on Fairless Works coke oven rails. Petticoat-type Porcelain Insulators resist contamination by dirt, moisture. Shock-proof, non-absorbent moulded type Insulators team up to protect over-running contact rails under severe conditions.



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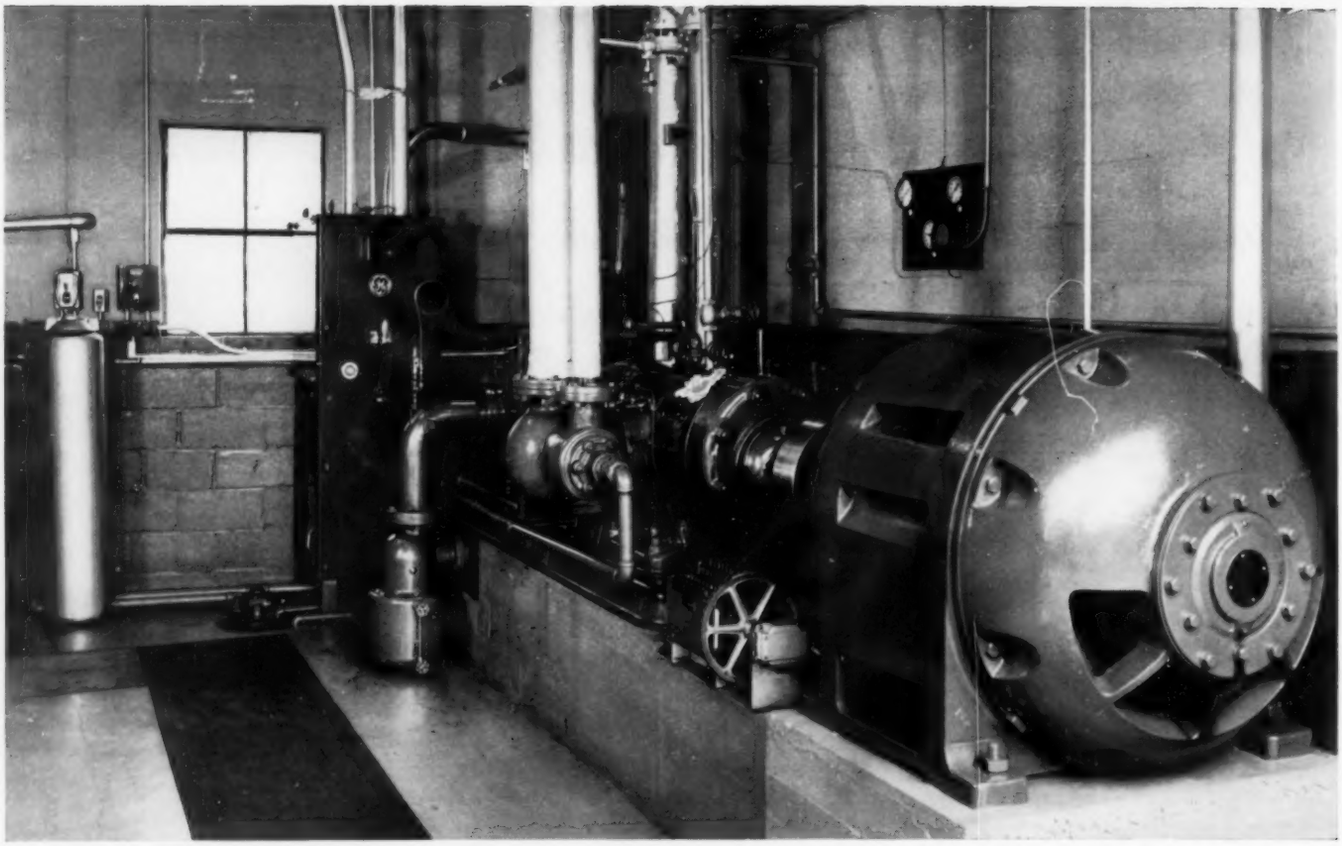

reliable ***Air Power*** *supplied by a*

FULLER ROTARY COMPRESSOR AT EMPIRE STEEL CASTINGS, INC.

Compressed air, supplied by a Fuller Rotary Two-stage Compressor, is used for many foundry operations at Empire Steel Castings Company, Reading, Pa. This machine has a capacity of 680 c.f.m., 100-lb. pressure.

Many operations are mechanized, using compressed air. Pneumatic rammers; squeeze and jolt machines; automatic set-out and lifting in connection with mold conveyors; automatic shakeout; mold cleaning and spraying. Drying; core oven and core blowing. Chipping hammers and grinders; blacksmith requirements; sand blasting; and pressure testing—a whole group of operations simplified by the use of compressed air supplied by the Fuller Rotary Compressor.

After constant, day after day operation for one year, (approximately 4000 hours operating time) it was found, upon inspection, that this machine was in first-class condition in every respect—in fact, maintenance for the period was nil.

In your own operation, compressed air can save time and money . . . especially when it is supplied by reliably efficient Fuller Rotary Compressors. Don't overlook the advantages of air power—put it to work.

Fuller Rotaries are built for capacities to 3300 c.f.m., 125-lb. pressure. For complete information, write for Bulletin C-5A.

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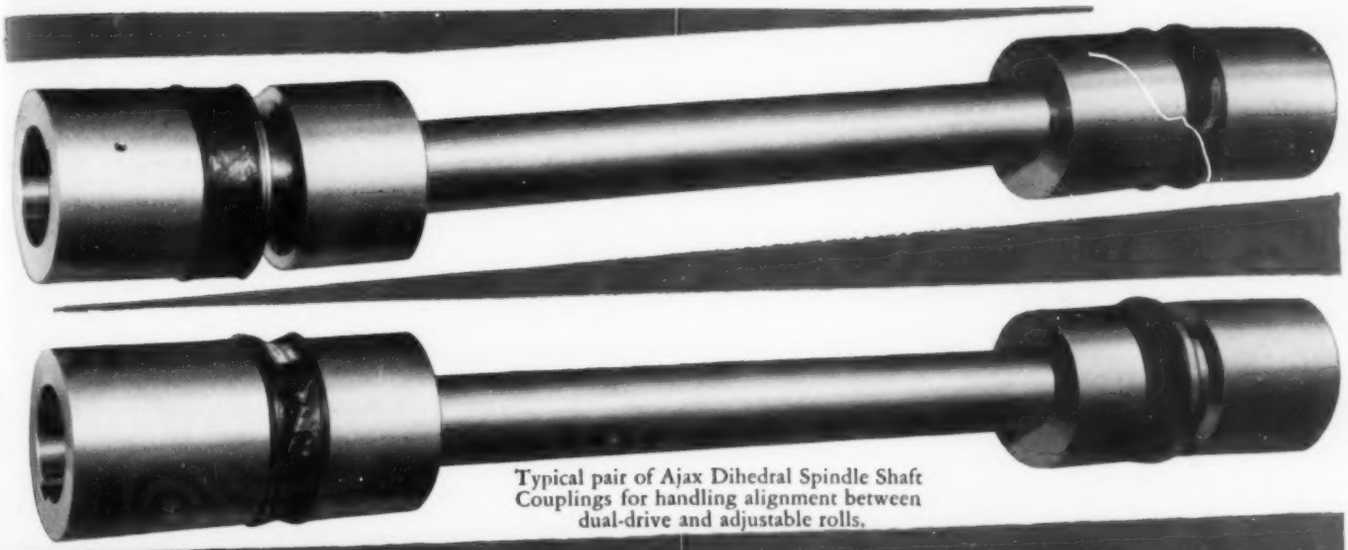
PIONEERS OF HIGH-EFFICIENCY VANE-TYPE ROTARY COMPRESSORS



Typical pair of Ajax Dihedral Spindle Shaft Couplings for handling alignment between dual-drive and adjustable rolls.

AJAX DIHEDRAL SPINDLE SHAFT COUPLINGS

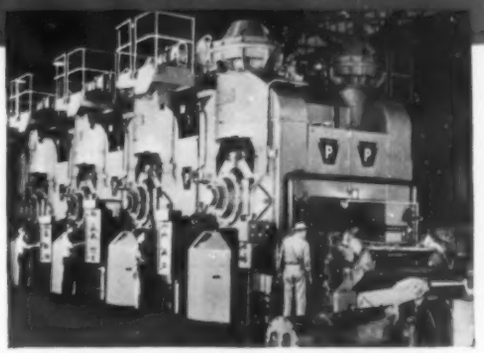
increase performance of New BLISS 4 Stand Tandem Mills

The performance of Ajax Dihedral Spindle Shaft Couplings is the talk of the steel industry! They have made all other types of conventional couplings obsolete.

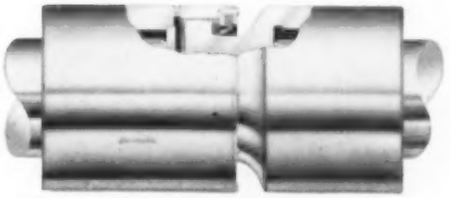
Mill operators are discovering how they eliminate frequent shutdowns for maintenance.

They like their continuous peripheral speed which results in smoother strip and far less wear on the rolls.

Write for full information on how Ajax exclusive Dihedral design is being welcomed by the industry.



Bliss 4-stand tandem cold reduction mill built for the Pittsburgh Steel Company and equipped with 8 Ajax Dihedral Spindle Shaft Couplings, 2 assemblies per stand.



Cut away view of Ajax Dihedral Coupling showing arrangement of teeth.

AJAX FLEXIBLE COUPLING CO. INC.

WESTFIELD, N. Y.

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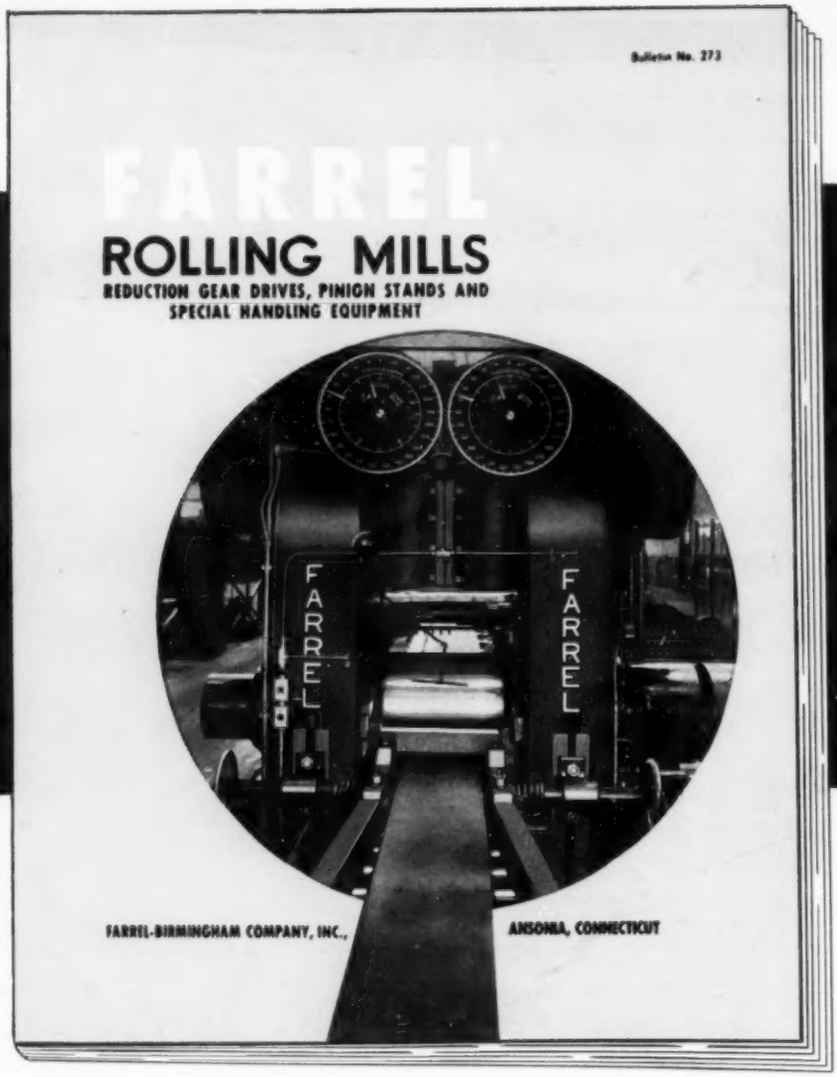

This 36-page bulletin contains a wealth of information about Farrel rolling mills, gear drives, pinion stands and special handling equipment. For example:

ROLLING MILLS—The first twenty-three pages contain illustrations and brief descriptions of more than thirty sizes and types of mills for rolling nonferrous rods, strips or sheets, metal foils and cold strip steel. These range in size from a 30″ x 36″ cold brass breakdown mill to a 6″ x 6″ self-contained unit suitable for laboratory work or specialized production.

REDUCTION GEAR DRIVES AND PINION STANDS—Under this heading you will find four pages of data on single and double reduction gear drives, pinion stands and combination units.

SPECIAL HANDLING EQUIPMENT—Pages 28 to 31 show examples of handling and manipulating equipment specially designed and built to meet individual requirements.

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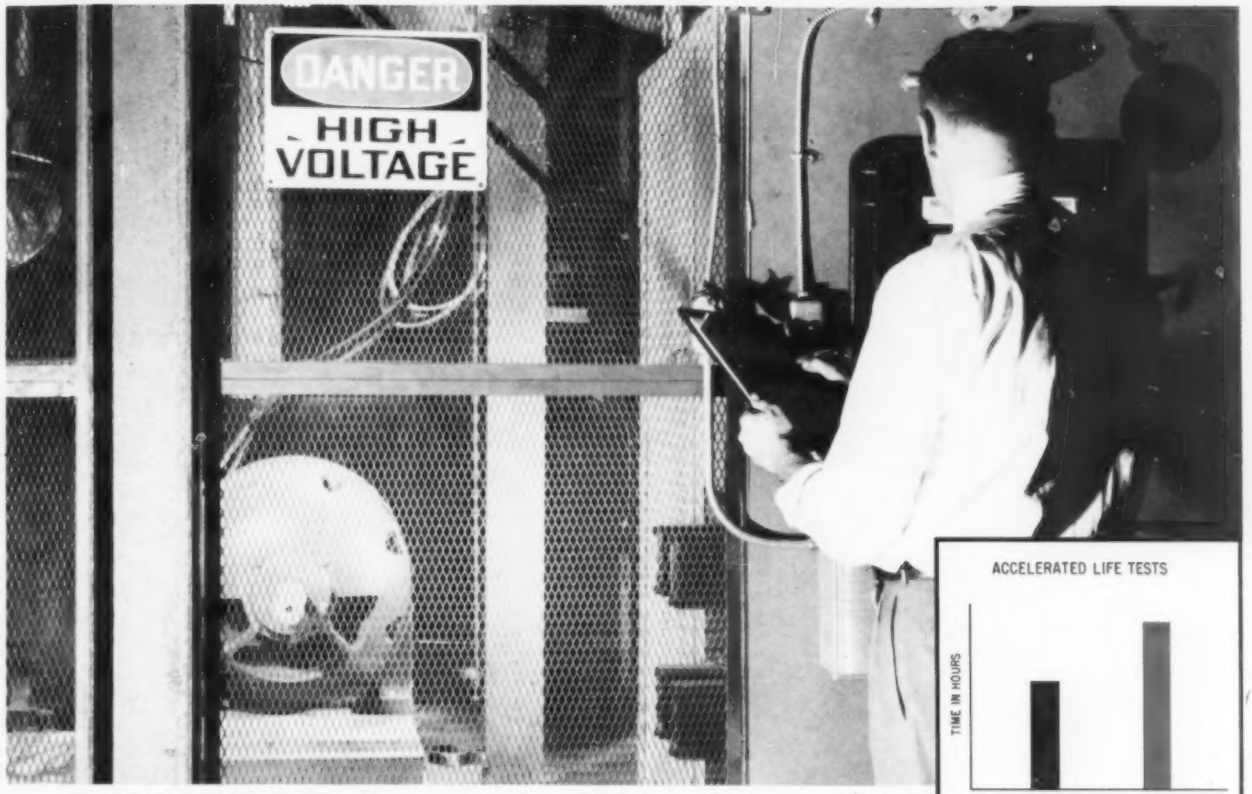
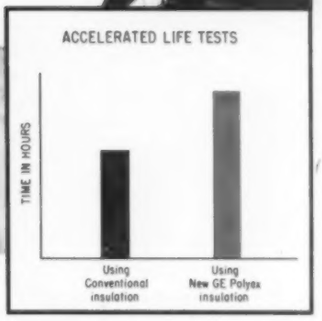
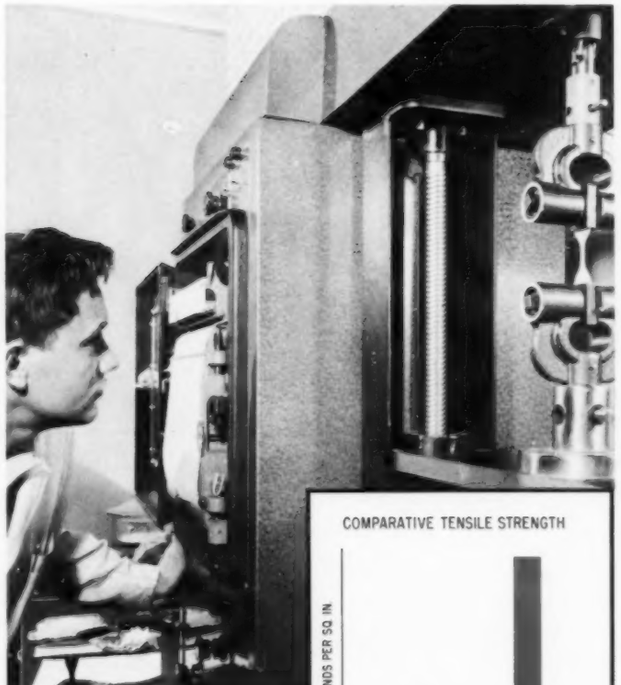
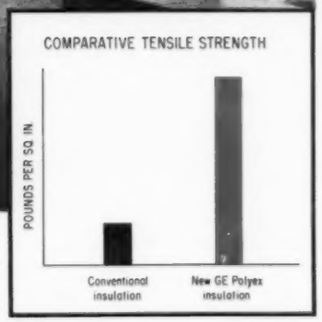




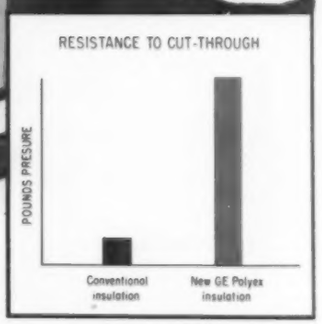
IN ACCELERATED LIFE TEST, General Electric's new Polyex insulation proved that it could take extreme heat aging and mechanical stress. Here is a summary of test results...

7 TIMES GREATER PHYSICAL STRENGTH





TENSILE STRENGTH of new insulation offers a greater protection against physical stress.



CUT-THROUGH STRENGTH, seven times greater than conventional insulation, is another reason for long life.

50% MORE

INITIAL DIELECTRIC STRENGTH ures insulation's ability to operating and starting voltage protection offered against insulat

An engineering

Gene Tha

REVOLUTIONARY OF THE AMAZING

General Electric has deve new Class A insulation for which lasts 50% longer than use today. Its greater ability ical and thermal stresses margin of protection that wi savings to you because of red and maintenance costs.

POLYEX INSULATION is a polyester films and fibres, hydrocarbon resins. Materi insulation have high diele

An engineering achievement of vital importance to users of m

General Electric Develops Ne
That is 7 Times Tougher, A

REVOLUTIONARY *POLYEX* INSULATION TAKES FULL ADVANTAGE OF THE AMAZING PROPERTIES OF NEW POLYESTER FILMS AND FIBRES

General Electric has developed a completely new Class A insulation for form-wound coils which lasts 50% longer than other insulations in use today. Its greater ability to withstand physical and thermal stresses provides an added margin of protection that will mean tremendous savings to you because of reduced motor failures and maintenance costs.

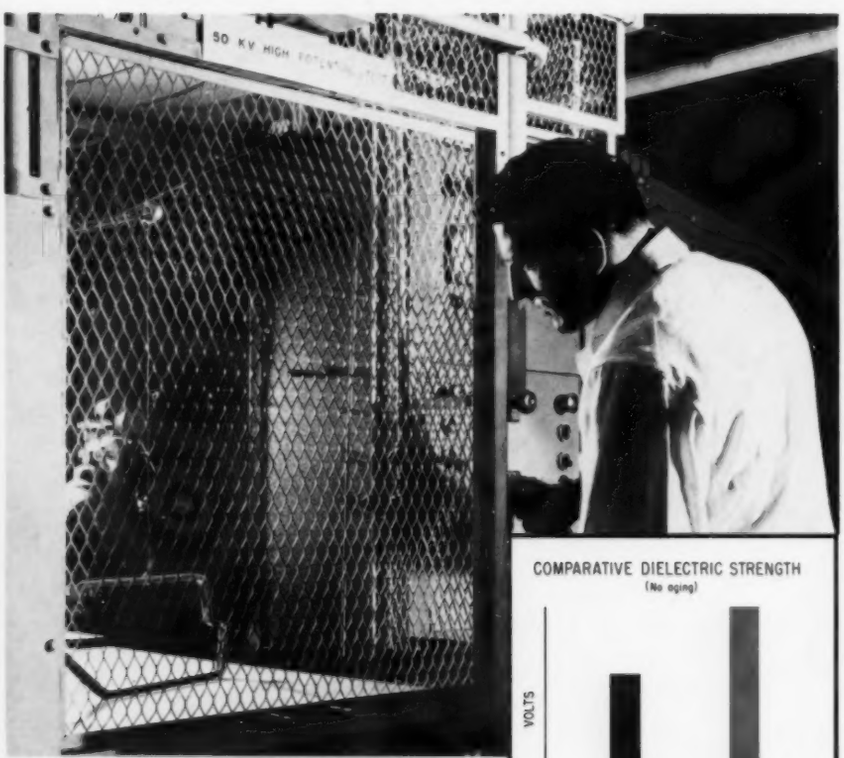
POLYEX INSULATION is a balanced system of polyester films and fibres, together with new hydrocarbon resins. Materials in new Polyex insulation have high dielectric and physical strength. For the first time, the cotton and paper-based tapes and sheets in conventional insulations have been eliminated.

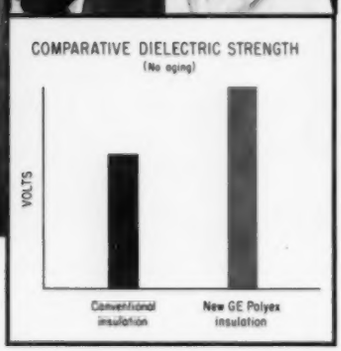
RESULTS OF EXHAUSTIVE TESTS on new Polyex insulation are summarized on these pages.

Insulation qualities like these offer you tremendous savings in motor maintenance and a greater degree of service continuity than ever before possible.

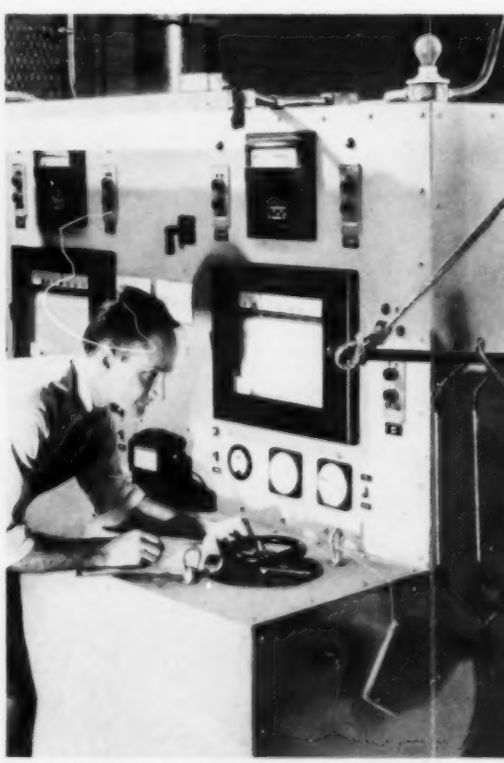
GENERAL ELECTRIC RESEARCH for better insulation is a continuing program. Polyex

50% MORE DIELECTRIC STRENGTH, EVEN AFTER HEAT A





INITIAL DIELECTRIC STRENGTH TEST measures insulation's ability to withstand operating and starting voltages, and the protection offered against insulation failure.



BAKED FOR THOUSANDS OF HOURS at 125°C, Polyex insulation was tested again. It proved that it retains its higher physical and dielectric properties after heat aging.

rs of motors with form-wound coils . . .

New Insulation for Motors , Adds 50% to Motor Life

insulation is the latest result of that program. Three years of intensive development and testing of materials and manufacturing techniques culminated in the most significant advance in large motor insulation in 45 years.

POLYEX INSULATION IS NOW AVAILABLE in many ratings of General Electric induction motors in the range of 100 to 3000 HP—and at no extra cost.

YOUR G-E SALES REPRESENTATIVE has complete information. Contact him at your nearby General Electric Apparatus Sales Office. *General Electric Company, Schenectady 5, New York.*

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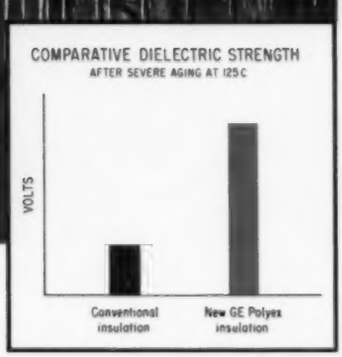
GENERAL ELECTRIC

IEAT AGING



IOURS at
ted again.
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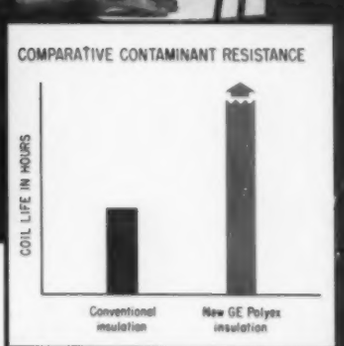
at aging.

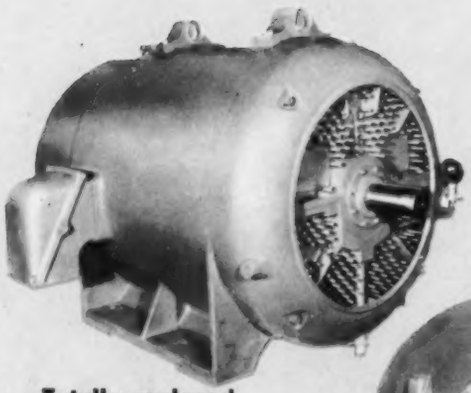
CONTAMINANT RESISTANCE DOUBLED

IN SALT SOLUTION, insulation's ability to resist contaminants was tested. Polyex-insulated coils were still operating long after conventional coils had failed.



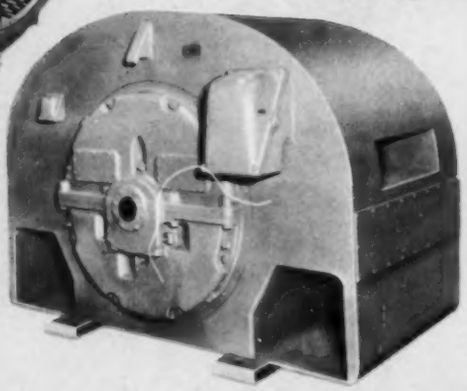
NOW AVAILABLE IN MANY RATINGS OF THESE G-E INDUCTION MOTORS

(Approximately 100 to 3000 hp)



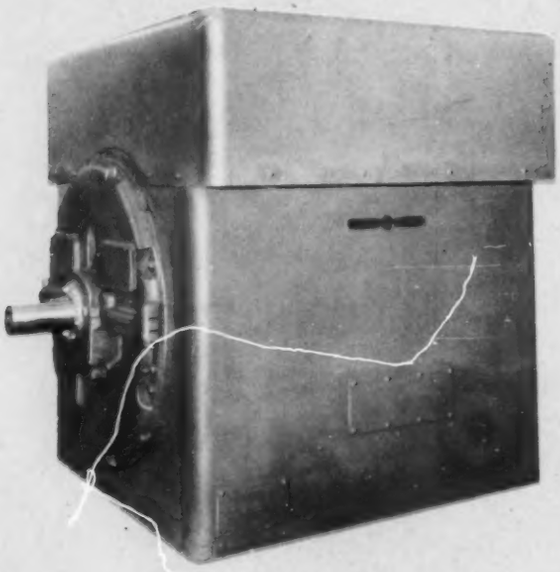
Totally-enclosed
fan-cooled

Open dripproof

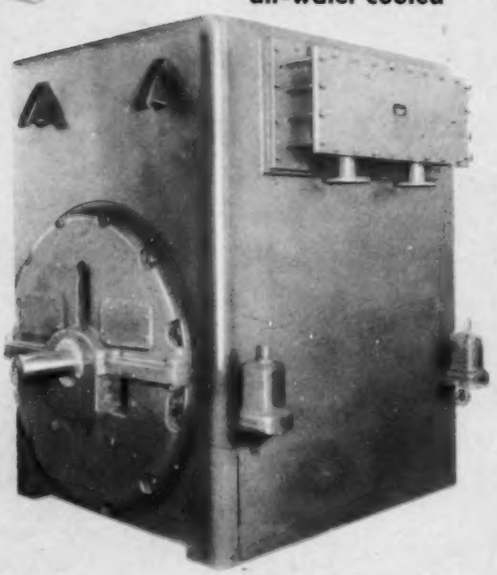


Grade-mounted
weather-protected

Base-ventilated
weather-protected



Totally-enclosed
air-water cooled



Progress Is Our Most Important Product

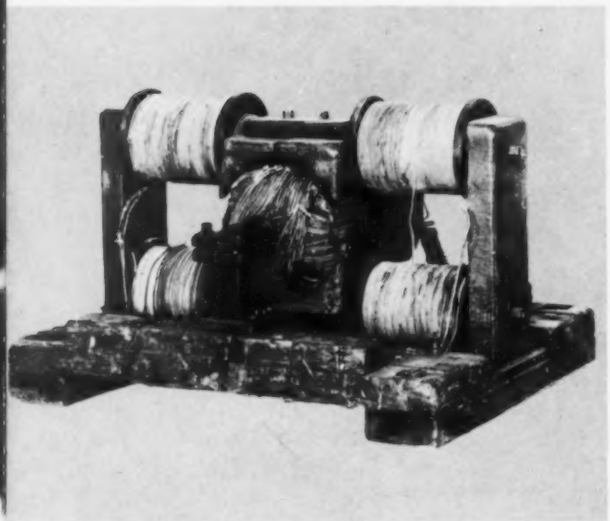
GENERAL ELECTRIC

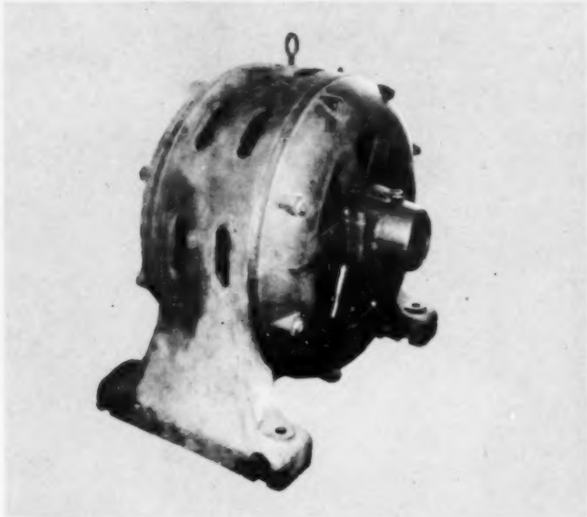
HIGH-POTENTIAL TESTS HELP PROVE . . .

NEW INSULATION MAKES G-E MOTORS LAST 50% LONGER

See Details Inside

THE THIRD MAJOR STEP IN THE EVOLUTION OF FORM-WOUND MOTOR INSULATION SYSTEMS





1878—FORM 1 INSULATION SYSTEM

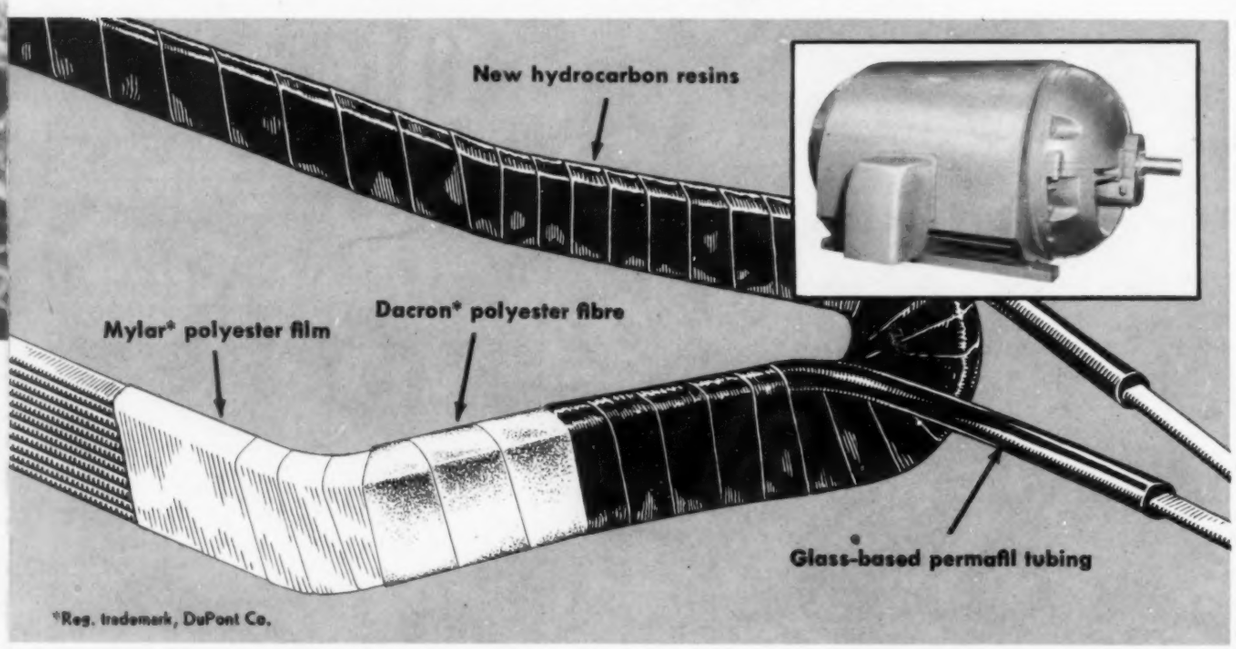
Air was the insulator in early motor coils. Cotton was wrapped around the coils, but served only as a spacer to provide an air gap. The cotton wrapping itself was worthless as an insulator.

1910—FORM 2 INSULATION SYSTEMS ESTABLISHED

Linseed oil was added to cotton to provide insulating qualities. Since then, varnish and other insulating materials have replaced oil, but until now the basic concept has remained the same.

1954—G.E. INTRODUCES FIRST FORM 3 INSULATION SYSTEM

New G-E Polyex insulation becomes the first Form 3 insulation system. Made of polyester films and fibres, Polyex is the first insulation in which the materials have natural insulating qualities of their own.



*Reg. trademark, DuPont Co.

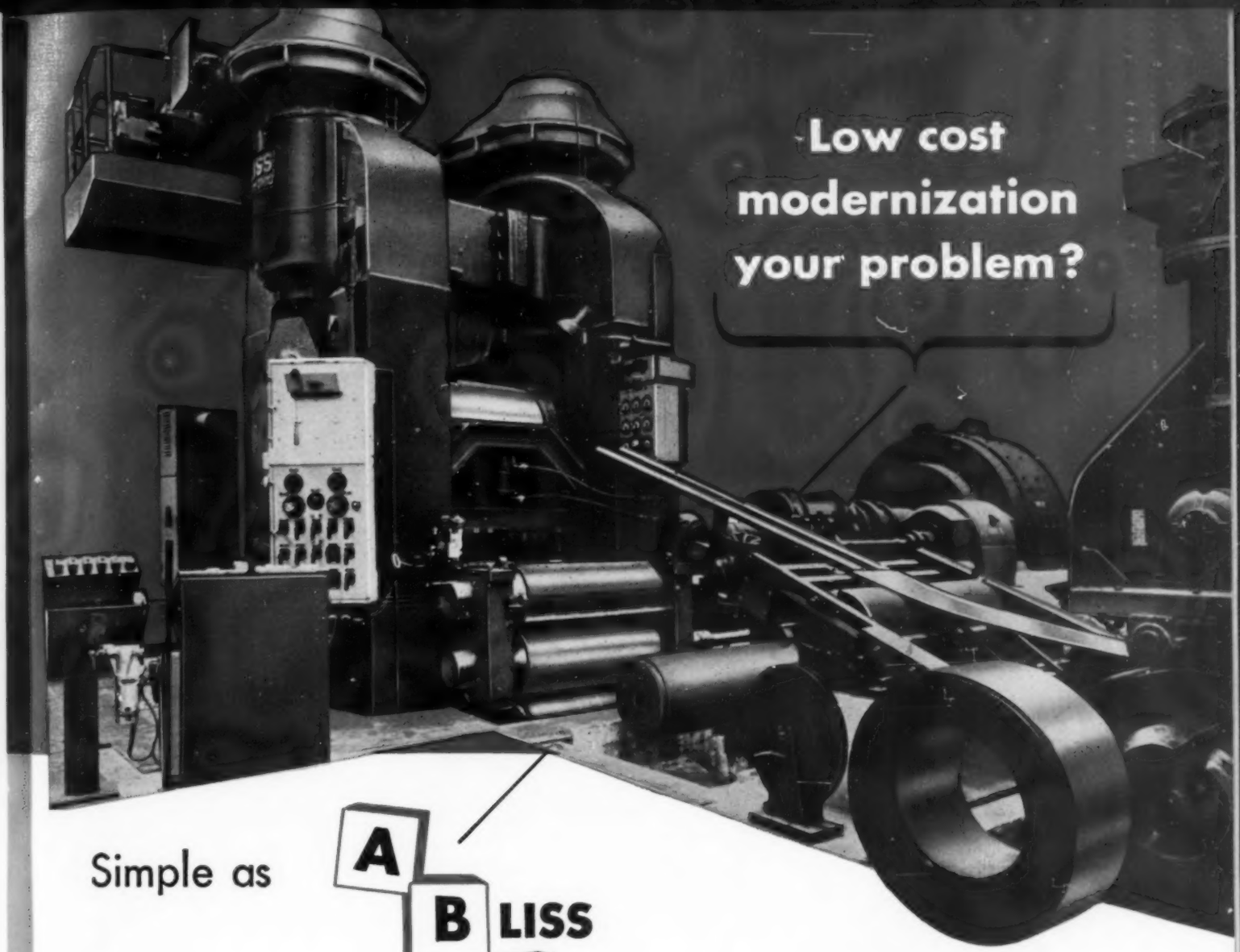
KES G-E
LONGER

Progress Is Our Most Important Product

GENERAL ELECTRIC

830-14

Want to keep this information? Tear along perforated edge.



Simple as A B LISS C ombination Mill

The problem of modernizing with limited funds was solved easily by executives of one prominent steel plant. They found that a *single* Bliss mill could replace *two* old special-purpose mills. By choosing a Bliss combination mill—designed for both cold reduction and temper pass work—they achieved advantages, not otherwise available, without a larger capital investment. These include:

- *Greater reductions, higher speeds, finer tolerances*
- *Conservation of valuable floor space*
- *Manpower savings with single operating crew*
- *Minimum idle mill time*

Bliss designed this versatile combination mill in order that changeover from cold reduction to temper rolling could be made quickly and easily. Special entry guides, tension bridle and other accessory equipment are supplied for this purpose, in the production of tin-plate as well as sheet stock.

If you, too, are interested in low cost mill modernization, consult Bliss. Meanwhile, write for your copy of the New 60-page Bliss Rolling Mill Brochure. Recently revised, it describes many modernization alternatives. Ask for Bulletin 40-A.

Remember: BLISS **for Presses, ROLLING MILLS, Special Machinery**

E. W. Bliss Company • General Office: Canton, Ohio

ROLLING MILL DIVISION: SALEM, OHIO

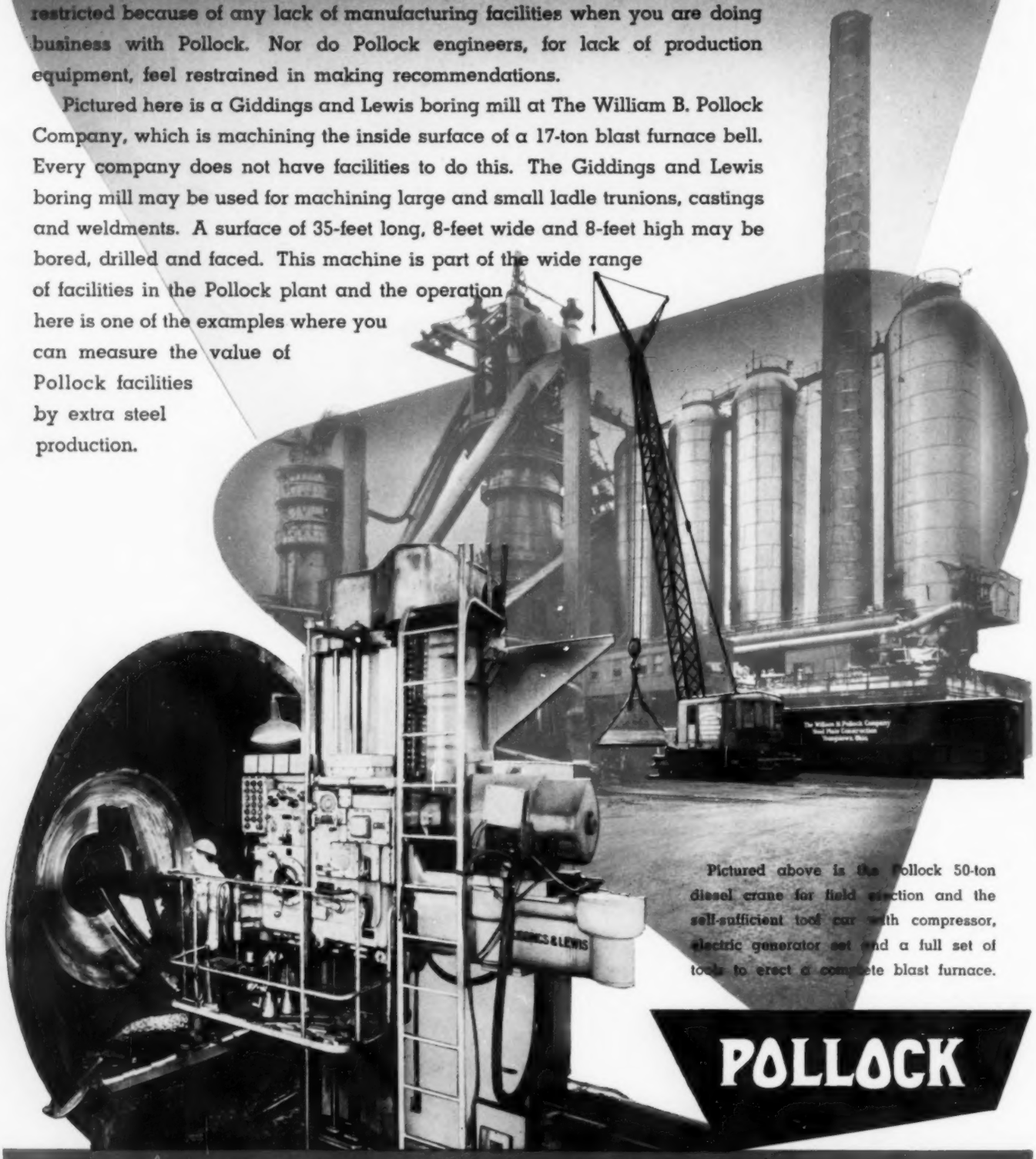
Subsidiary: The Die Supply Company, Cleveland, O. • E. W. Bliss (England) Ltd. • E. W. Bliss Company (Paris) France

U. S. Plants in Canton, Salem and Toledo, Ohio; Hastings, Michigan; and San Jose, Calif. Branch Offices in Chicago, Cleveland, Dayton, Detroit, Indianapolis, New Haven, New York, Philadelphia, Rochester, Toledo, and Toronto, Canada.
West Coast Representatives: Star Machinery Company, Seattle. Other representatives throughout the world.

POLLOCK facilities encourage higher specification standards in steel construction

Your progressive ideas for blast furnaces and steel plants are not restricted because of any lack of manufacturing facilities when you are doing business with Pollock. Nor do Pollock engineers, for lack of production equipment, feel restrained in making recommendations.

Pictured here is a Giddings and Lewis boring mill at The William B. Pollock Company, which is machining the inside surface of a 17-ton blast furnace bell. Every company does not have facilities to do this. The Giddings and Lewis boring mill may be used for machining large and small ladle trunions, castings and weldments. A surface of 35-feet long, 8-feet wide and 8-feet high may be bored, drilled and faced. This machine is part of the wide range of facilities in the Pollock plant and the operation here is one of the examples where you can measure the value of Pollock facilities by extra steel production.



Pictured above is the Pollock 50-ton diesel crane for field erection and the self-sufficient tool car with compressor, electric generator set and a full set of tools to erect a complete blast furnace.

POLLOCK

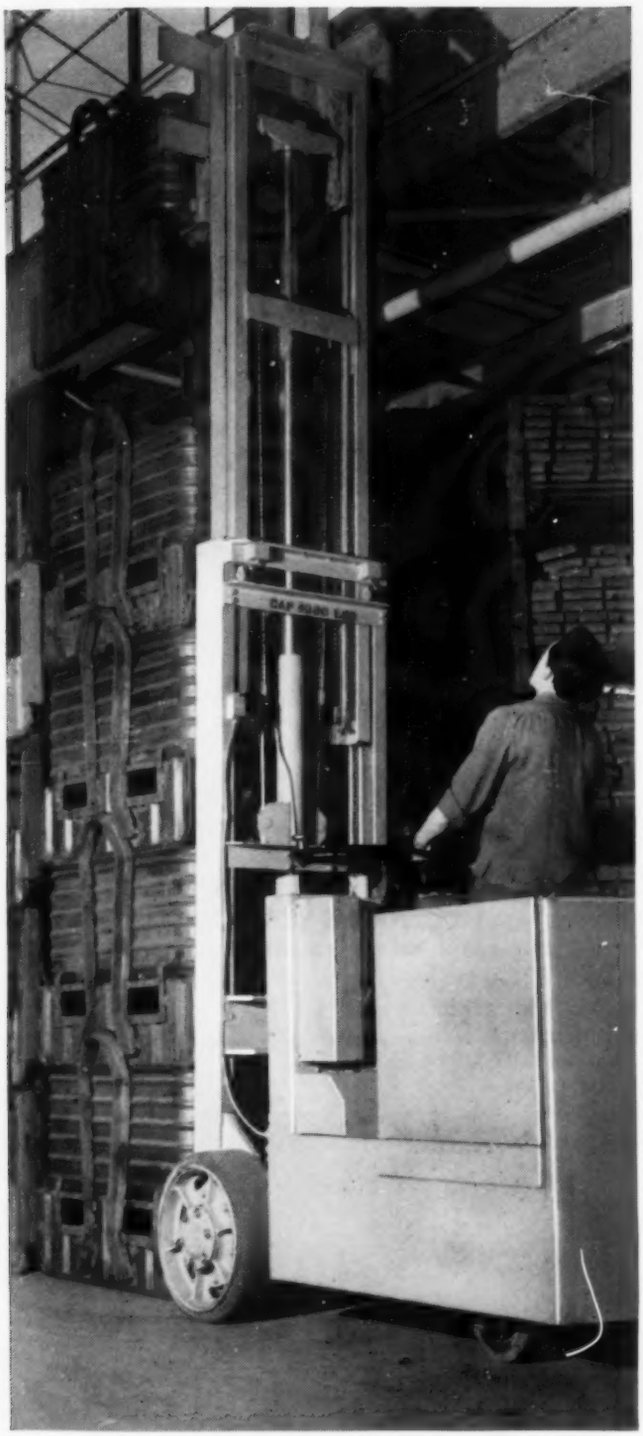
THE WILLIAM B. POLLOCK COMPANY • YOUNGSTOWN, OHIO

STEEL PLATE CONSTRUCTION · ENGINEERS · FABRICATORS · ERECTORS

BLAST FURNACES · HOT METAL CARS AND LADLES · CINDER AND SLAG CARS · INGOT MOULD CARS · CHARGING BOX CARS · WELDED OPEN HEARTH LADLES

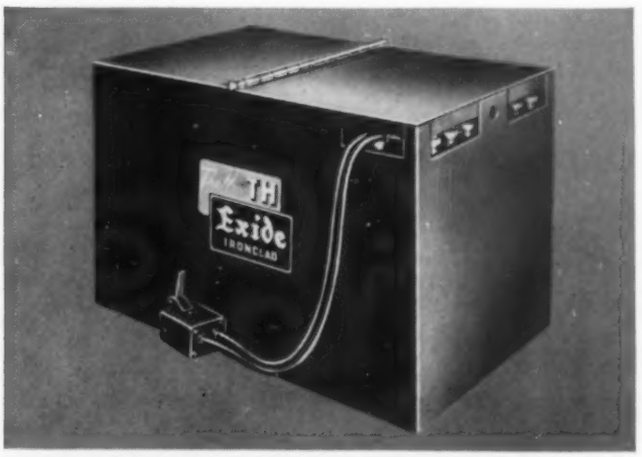
GET "FINGER-TIP" CONTROL, MORE LIFTS PER SHIFT

...with low cost Exide-Ironclad battery power!



ACCURATE STACKING, precise spotting, are essential for fast, safe materials handling. Exide-Ironclad Batteries respond instantly to any power need required for rapid, accurate handling operations. They enable trucks to handle as much load in the last hour of the shift as during the first ...with no unscheduled down time. Lower costs for operation, maintenance, and depreciation make Exide-Ironclads the best power buy—AT ANY PRICE.

THE POSITIVE PLATES are the heart of any battery. Only Exide uses a slotted tube construction. By use of tubes, more active material is exposed to the electrolyte, providing *greater power.* Also, more active material is retained, *giving longer working life.*



THE NEW THRIFTY HAULER! The improved industrial truck battery. *Non-oxidizing* plastic power tubes assure longest battery life, more capacity in the same space. For full details, call your Exide sales engineer—write for Form 1982 (Installation and Maintenance of Motive Power).

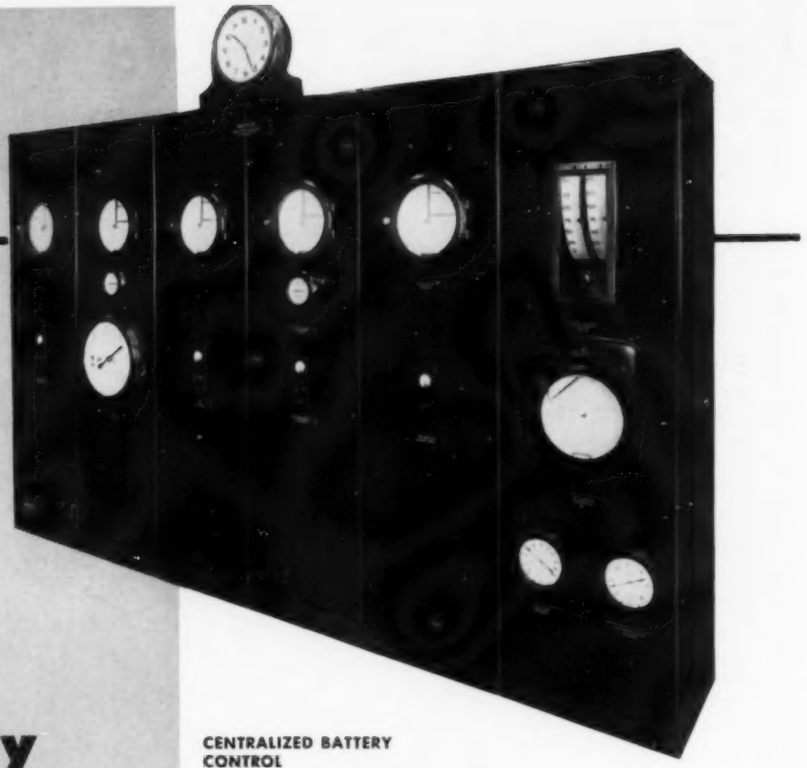
Your best power buy ...AT ANY PRICE!

Exide®
IRONCLAD® BATTERIES

Exide INDUSTRIAL DIVISION, The Electric Storage Battery Company, Philadelphia 2, Pa.

Newest

REPUBLIC CONTROLS installed on coke battery



CENTRALIZED BATTERY CONTROL
at this panel permits an operator to coordinate automatic regulators controlling stack draft, fuel gas volume and pressure and blast furnace gas pressure. Gages and regulators monitor the system.

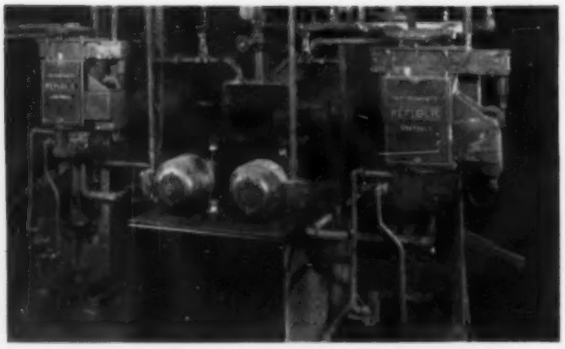
When a new coke battery was added to the coke plant of a mid-western steel mill, Republic electrically controlled hydraulic regulators were installed to control the additional capacity. These new type regulators supplement Republic-Smoot regulators which have been in operation on some of the older batteries for more than 34 years. Dependability, the determining factor in the selection of the new equipment, was more than proven by the performance of the older controls.

The same features—ruggedness and simplicity—which kept these controls in continuous service year after year are embodied in modern Republic Instruments and Controls. That's why Republic equipment remains dependable, regardless of dirt, heat, shocks and vibration. It's also why steel mills such as this one specify Republic, again and again.

GET ALL THE FACTS ABOUT REPUBLIC INSTRUMENTS AND CONTROLS FOR STEEL MILLS

- **ELECTRIC FLOW METERS** for continuous integration and fast transmission of flow information
- **PNEUMATIC ELECTRIC FLOW METERS** for oxygen scarfing and dirty gases
- **LOW PRESSURE RECORDERS** for open hearths, soaking pits, coke ovens, reheating furnaces, smelting furnaces
- **HIGH SPEED POSITIONING OPERATOR** for furnace doors
- **FURNACE PRESSURE REGULATORS**
- **FLOW REGULATORS**
- **BTU TOTALIZERS** for more efficient operation of open hearth furnaces

Write for literature on any of the above



ELECTRICALLY CONTROLLED REGULATORS. The control point of these Republic hydraulic type regulators is set electrically from control panel. In case of failure of hydraulic system, oil trapping valve will lock the regulators in their last position before failure. Electrical failure or accidental shorting of the transmission lines will not cause regulators to shift their control setting.

STILL IN SERVICE AFTER 34 YEARS. These old type Republic-Smoot regulators were installed in 1919 when the coke batteries were built. They operate on the force-balance principle, which permits strong, durable construction without loss of accuracy or sensitivity. This same operating principle is used in modern Republic regulators and pneumatic transmitters.

REPUBLIC FLOW METERS CO.
2240 Diversey Parkway, Chicago 47, Illinois

"Alloys for the Furnaces." Agnes Potter Lowrie depicts the ingredients which give steel its special qualities: reddish manganese for deeper hardening; ice-white quartz for flux, flanked (left) by tungsten and (right) by chrome, corrosion preventives for special-purpose steels; dusky lead glistening with molybdenum which maintains hardness at high temperatures; and (bottom row) samples of nickel, molybdenum and chrome, vanadium, copper. Limited edition of 15 x 18 full-color prints available soon. Copy on request.

The Fine Art of Steel Making #V

Advances in metallurgy have given us *finer* steel than ever before, harder, finer-grained, more resistant to heat, friction, corrosion.

Advances in mechanics have given us *more* steel. Today's four-high mill, for instance, rolls more steel in a single shift than the old-time hand mill produced in a week.

Contributing mightily to more efficient production are equal improvements in the materials which smooth the process of steel making — Ironsides roll neck and roller bearing lubricants.

Roll neck shield, once applied by hand, is now supplied in liquid and semi-liquid form for continuous application by automatic pressure systems. Roll necks may be kept at constant temperature; the roller need not adjust his mill to maintain proper gauge.

More important, roll neck shield is formulated to the special needs of the individual user. For example, to compensate for local water and temperature conditions or to meet personal preferences of mill superintendents.

Roller bearing shield, an extreme pressure lubricant, has load-carrying capacity in excess of bearing manufacturers' standards, assuring a safety factor for peak loads. It carries the approval of all top bearing makers.
Today almost every major steel producer uses Ironsides lubricants. Our unique position is due to our ability to formulate for special applications and supply those formulas in any quantity.

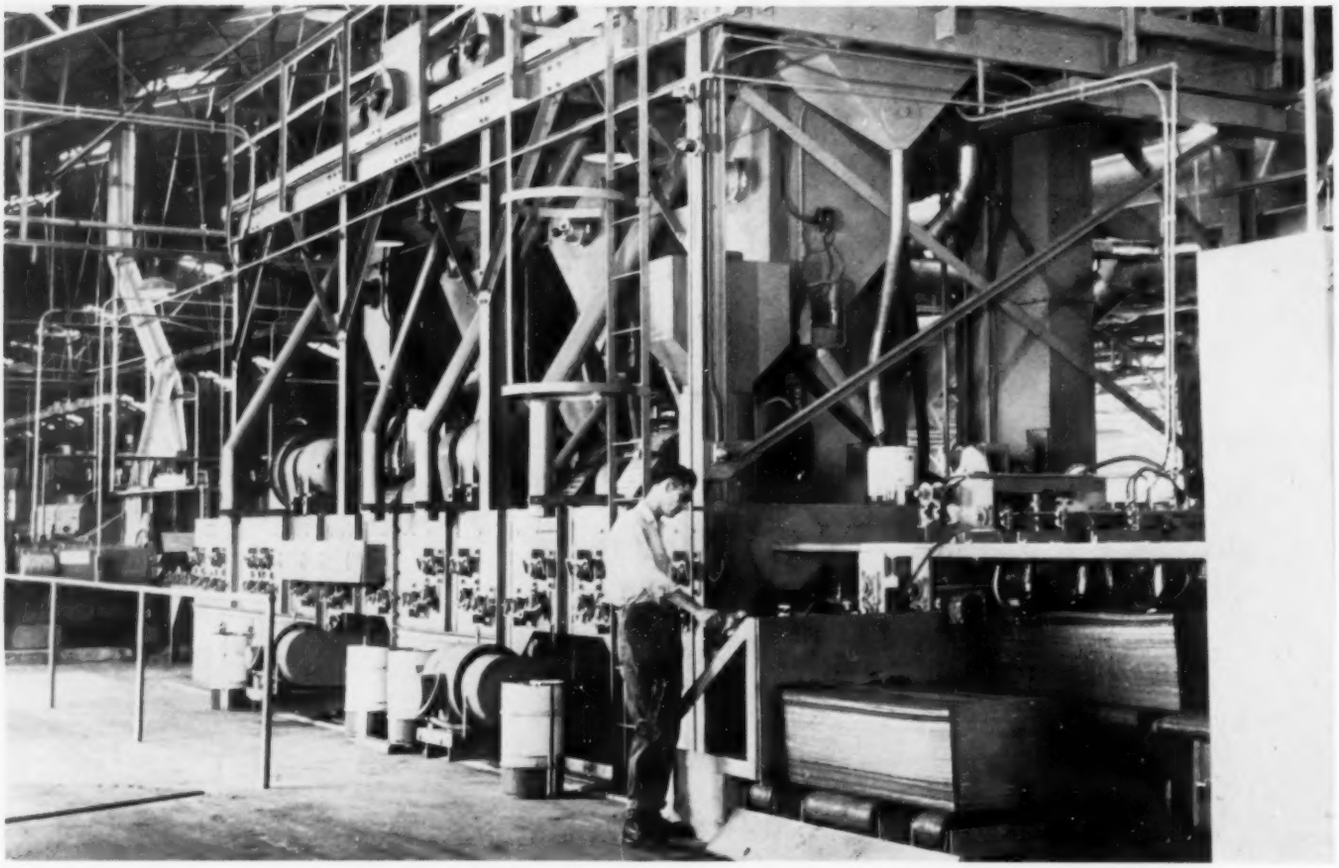
We like tough problems; we've solved a lot of them. For example, Palmoshield, replacement for palm oil and most significant advance in lubrication since World War II. If you have a problem, we'd like to help lick it. A letter will summon one of our research engineers. The Ironsides Co., Columbus 16, Ohio.

SHIELD PRODUCTS

Ironsides

By the makers of Palmoshield • "the palm tree that grows in Ohio"

pioneering developments keep WHEELABRATOR® first in blast cleaning



How WHEELABRATOR® MECHANICAL CLEANING

of Hot Rolled Steel Sheets Reduces Cleaning Costs per ton.

Operating results of airless Wheelabrator mechanical cleaning equipment for removing scale from hot rolled steel sheets have proved that other methods do not equal its cost-cutting performance and high speed cleaning efficiency.

In each of the seven drum plants of Rheem Manufacturing Co., for example, Wheelabrator machines have greatly reduced the cost of cleaning 18-gauge steel sheets used in the manufacture of their new Rheemcote lithographed steel drums. In other steel processing plants and steel mills, the Wheelabrator is also effecting impressive results in low cost, high production and providing extra benefits in improved surface cleanliness and better working conditions.

These production economies are a result of perfected equipment design coupled with the controlled abrasive blast of the Wheelabrator unit. With the introduction of Wheelabrator Steel Shot, equipment operating and maintenance costs are extremely low and continuous, high-production mechanical cleaning of hot rolled products is now in actual practice.

We would be glad to demonstrate the savings the Wheelabrator can make for you. Write today for full details and an appointment to see the Wheelabrator in operation.

Bulletin 894 describes the descaling of Steel Strip and Bulletin 914 describes the descaling of steel sheets. Send for your copies today.

American
WHEELABRATOR & EQUIPMENT CORP.
396 S. Byrkit St., Mishawaka, Ind.

Wheelabrator®
AIRLESS BLAST CLEANING

FOR

MAIN DRIVE MOTORS AND GENERATORS • ROTARY CONVERTERS • HEAVY-DUTY GENERAL-PURPOSE MOTORS

IMPROVES MACHINE PERFORMANCE...

One of the most outstanding brush developments in twenty years, the new "National" N-4 brush is especially recommended where heavy load-swings require exceptional brush characteristics to assure smooth, trouble-free operation. The ability of this new, "National" brush grade to deliver peak-commutation under the most difficult service conditions is *one* of its outstanding characteristics.

CUTS OPERATING COSTS...

Users of the new N-4 brush report up to *twice the brush life* ever obtained with any previous grade. Such results occur *wherever* N-4 brushes are applied to main drive motors and generators, rotary converters and heavy-duty motors. And here's more good news – N-4 brushes cost no more than comparable grades now being used in these services!

The term "National", the Three Pyramids device and the Silver Colored Cable Strand are registered trade-marks of Union Carbide and Carbon Corporation

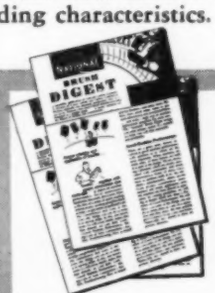
NATIONAL CARBON COMPANY

A Division of Union Carbide and Carbon Corporation

30 East 42nd Street, New York 17, N. Y.

Sales Offices: Atlanta, Chicago, Dallas, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco

In Canada: Union Carbide Canada Limited, Toronto



YOURS FOR THE ASKING... Dept. IS 1-5

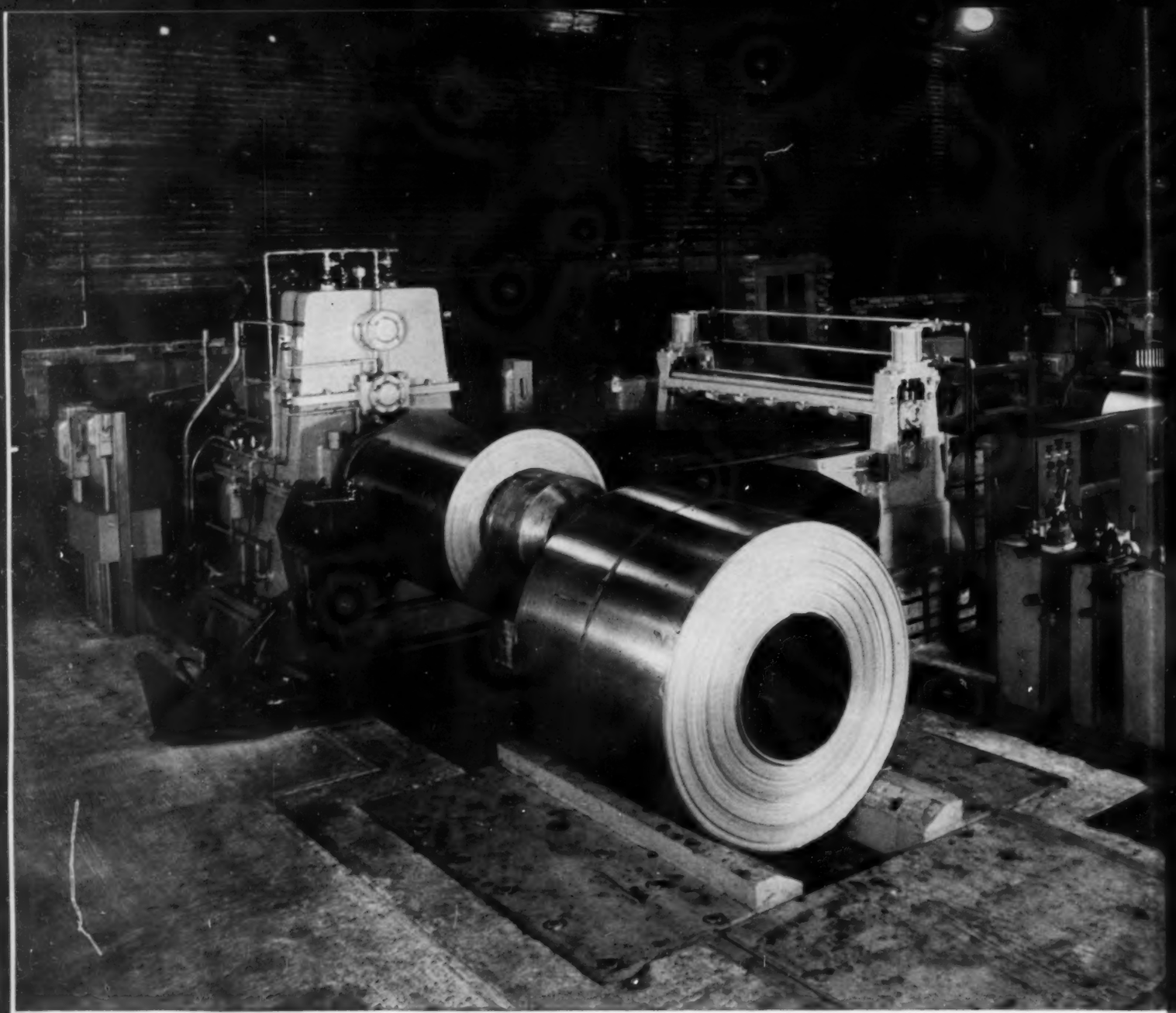
National Carbon's instructive pamphlet series on the practical aspects of motor and generator maintenance. Supervisors should request as many copies as they need to distribute personally to their men. Coupon automatically brings back-issues and each new, bi-monthly issue for two years or more.

NAME_____ TITLE_____

COMPANY_____

ADDRESS_____

No. of copies_____ Signed_____



Wean Flying Shear Line (Entry End)

The Wean ENGINEERING COMPANY, Inc.

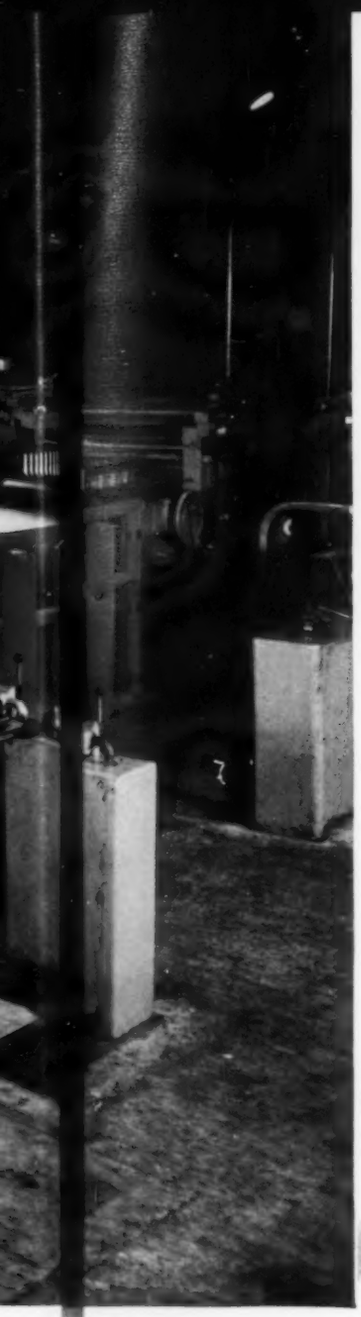
WARREN ---------- OHIO

In the past decade steel making has made advancements in produ development and production unmatched by any other industry.

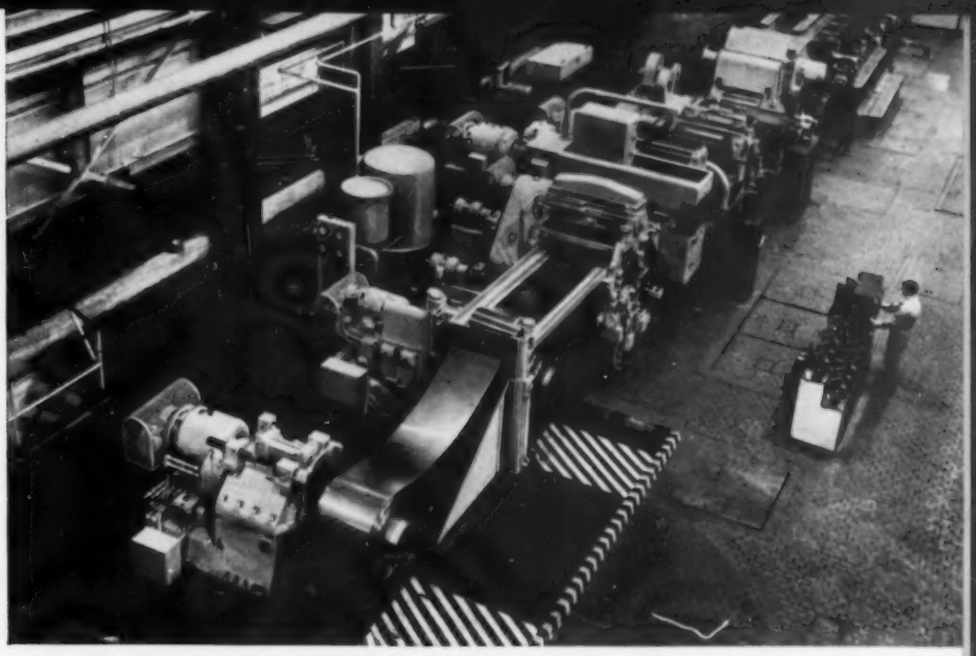
The demand for better, more versatile steels, at rates that a few sh years ago were beyond comprehension, has furnished the impetus. B the backbone of this tremendous revolution has been supplied by e perienced metallurgists, who developed the materials, and engineeri firms, like Wean, who designed and built the machinery necessary.

The equipment pictured on these pages is typical. Wean-Hallden she lines, cleaning and coating lines are rewriting performance recor wherever they are in operation. This is the kind of progress that caus leading steel producers the world over to make certain they talk wi Wean before they buy.

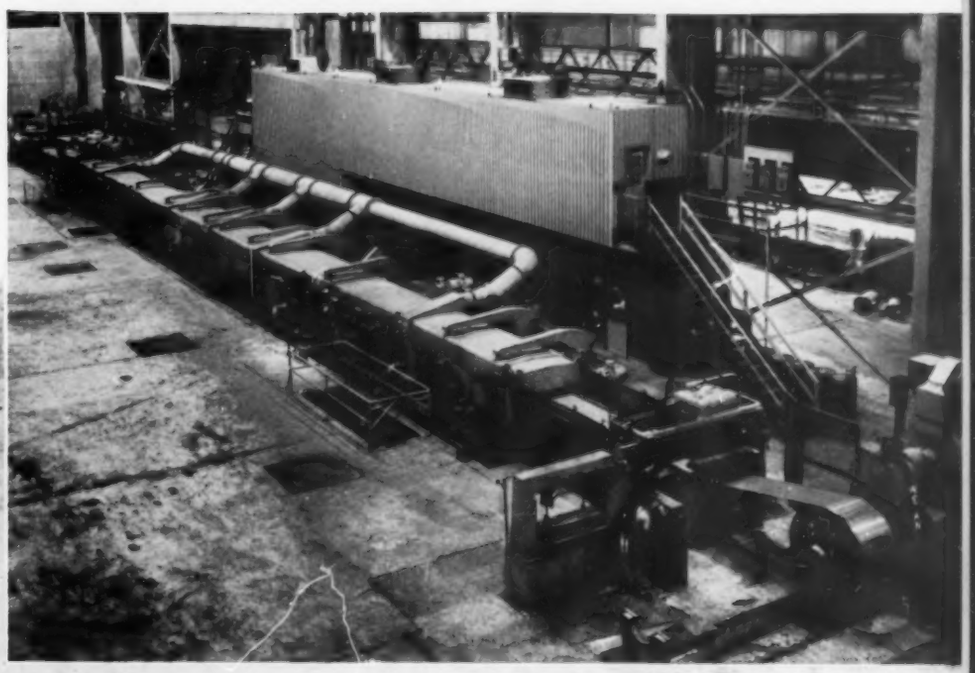
SPECIALISTS IN SHEET, STRIP AND TIN MILL EQUIPMENT



Wean Continuous
Coating Line



Wean Electrolytic
Cleaning Line



Cleveland Cranes
FOR
STEEL MILL SERVICE

CLEVELAND CRANES

MODERN ALL-WELDED STEEL MILL CRANES

5031 EAST 289th ST.
WICKLIFFE, OHIO

Crops *and* Shorts

CLIFFORD F. Hood, president of United States Steel Corp., believes that the greatest challenge to industrial management today is to restore to the minds of employees the urge to work for advancement under free enterprise. Industry is concerned over the many employees who are indifferent and apathetic about their work and their relations with their company. These attitudes may be one reason why our economy is not propelled fully toward the kind and degree of economic freedom which can increase our national rate of progress.

Mr. Hood blames this situation on "the incessant, often dishonest barrage of propaganda which has been leveled at the employee group as well as our population in general by the enemies of our way of life." He feels that an educational program, somewhat different than any attempted by management in the past, is necessary. Management has not applied the same genius in this area as has been demonstrated so ably in the field of technology.

▲

SPEAKING before the Public Relations Society of America, B. F. Fairless, board chairman of U.S. Steel, called for an all-out attack on the fatal delusion that economic freedom may be surrendered without sacrifice of individual liberty. He believes the existence of this spurious notion to be a "shocking commentary upon the inadequacies of our entire public relations effort to date."

▲

FURTHER food for thought along this same line lies in the results of a survey made by the United States Chamber of Commerce of 86 high schools scattered over the country. It was found that the majority of the senior students think that owners get too large a share and workers too little of the benefits of new machines and new processes. About 55 per cent believe in "pay according to means, receive according to need."

If this sampling accurately portrays the overall sentiments, then an educational program is urgently needed, and our school curricula should be scrutinized. Perhaps a completely new approach is needed, using comic books and other techniques which are apparently so successful in building these sentiments.

▲

PERHAPS we should return to the idea that there are three classes of people: Those who don't do all their duty, those who do full duty, and those who do more than their duty. The first lose their jobs, the second hold them and the third are promoted.

▲

WE all think of February as the time for Lincoln's and Washington's birthdays, valentine day and groundhog day. But in the remote possibility that you're interested, it also contains National Kraut and Frankfurter Week, Boy Scout Week, Americanism Week, Advertising Week, Table Tennis Week, National Crime Prevention Week, National Lutheran Publicity Week, National Cherry Week, Catholic Book Week, National Beauty Salon Week and Brotherhood Week, as well as Childrens' Dental Health Day, Catholic Author Day, Heart Sunday, World Day of Prayer for Students, Shrove Tuesday, Ash Wednesday, Baptist World Alliance Sunday and Race Relations Sunday.

▲

A dispute between United States Steel Corp. and Kaiser Steel Corp. over iron ore prospecting claims in southern California gives rise to speculation as to the possibility of U. S. Steel plans for an integrated steel plant in that area.

▲

NOW that we've got all these so-called improvements on the new automobiles, how about some genius devising brakes that will stop the car behind us?

▲

STEEL producers of the United States are somewhat concerned over continued scrap shipments out of the country. They believe that steel production in the United States could suffer from scrap shortage unless rising scrap exports are curbed.

The U. S. government recently refused a request by steel producers to restrict scrap exports, but did agree to license exports through the first quarter of 1955 and watch the volume.

▲

THE fellow across the hall says that bacteriologists may be right in their report that kissing is safer with lipstick, but not if you forget to wipe it off.

▲

IN spite of the comparatively low rate of steel operations in general during 1954, Republic Steel Corp.'s Warren District set new plant production records for both iron and steel. Warren's single blast furnace produced approximately 600,000 tons of iron, while the eight open hearth furnaces turned out about 975,000 tons of ingots.

▲

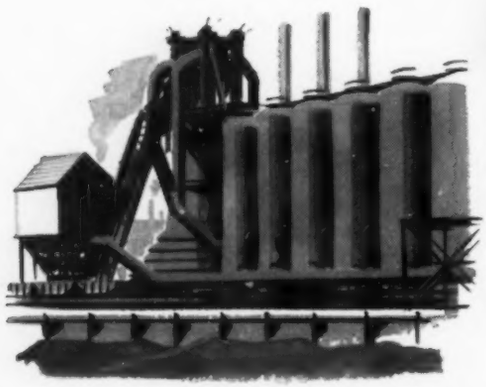
IN the four-year period from 1947 to 1951, when the Taft-Hartley Act required union-shop authorization elections, unions were able to muster only about 5,000,000 votes in favor of the union shop out of their claimed membership of 17,000,000 and a total labor force of some 60,000,000 persons employed in the United States — in other words, less than one-third of their members, and less than 10 per cent of all employees, voted for compulsory unionism.

Should the tail wag the dog?

HAGAN

AIR-OPERATED CONTROLS

The many successful installations of Hagan Air-Operated Controls and Hagan Ring Balance Instruments demonstrate Hagan leadership in the steel industry. These applications emphasize the versatility of Hagan Control and Instrumentation.

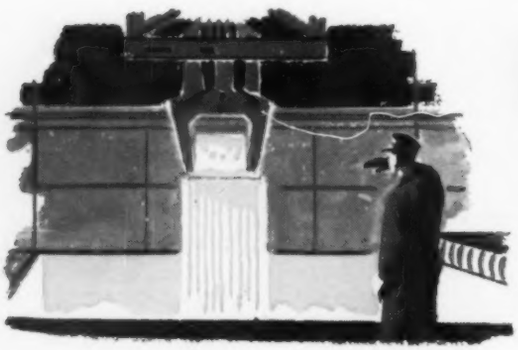


BLAST FURNACES

Blower delivery control on volumetric or constant weight basis · Pressure and temperature compensated air flow meters · Air distribution control · Bleeder valve control · Gas distribution metering and control · Flow meters for water, steam · Stove burner gas input and gas-air ratio control.

OPEN HEARTH AND HEATING FURNACES

Total heat input control and fuel-air ratio control for single or multiple fuels · Furnace pressure control · Oxygen flow metering and control · Fuel and air reversal control · Btu meters for gas firing · Draft and pressure recorders · Flow metering for steam, oil, gas or water.



SOAKING PITS

Fuel input control · Fuel-air ratio control · Reversal control · Gas pressure control · Furnace pressure control · Waste gas flue draft control · Draft and pressure recorders · Flow metering for steam, oil, gas or water.

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RING BALANCE INSTRUMENTS

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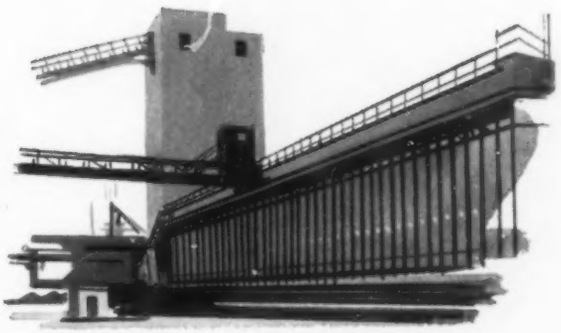

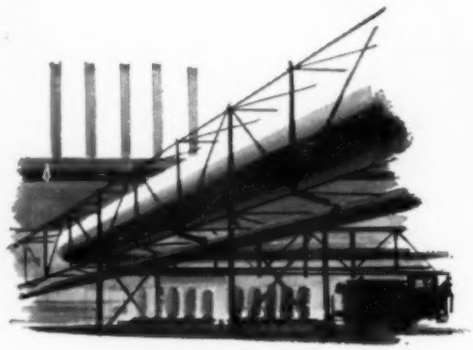

GAS DISTRIBUTION SYSTEMS

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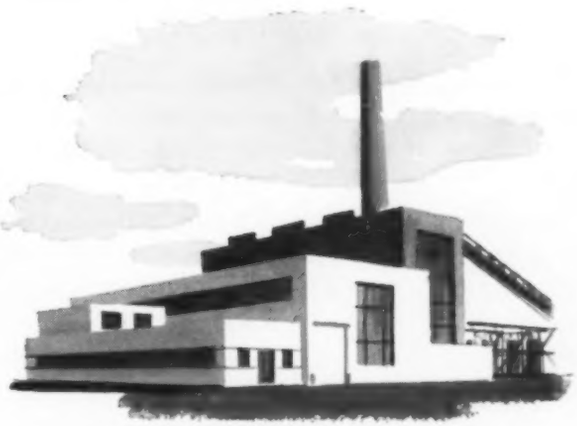
BOILER HOUSES

Steam pressure control · Automatic control of single or multiple fuel input, firing separately or simultaneously · Control of load distribution · Fuel-air ratio control · Furnace draft control · Boiler drum water level control · Flow metering for steam, oil, gas and water · Automatic compensation of flow readings for pressure and temperature variations · Pneumatic and electric signal transmission.



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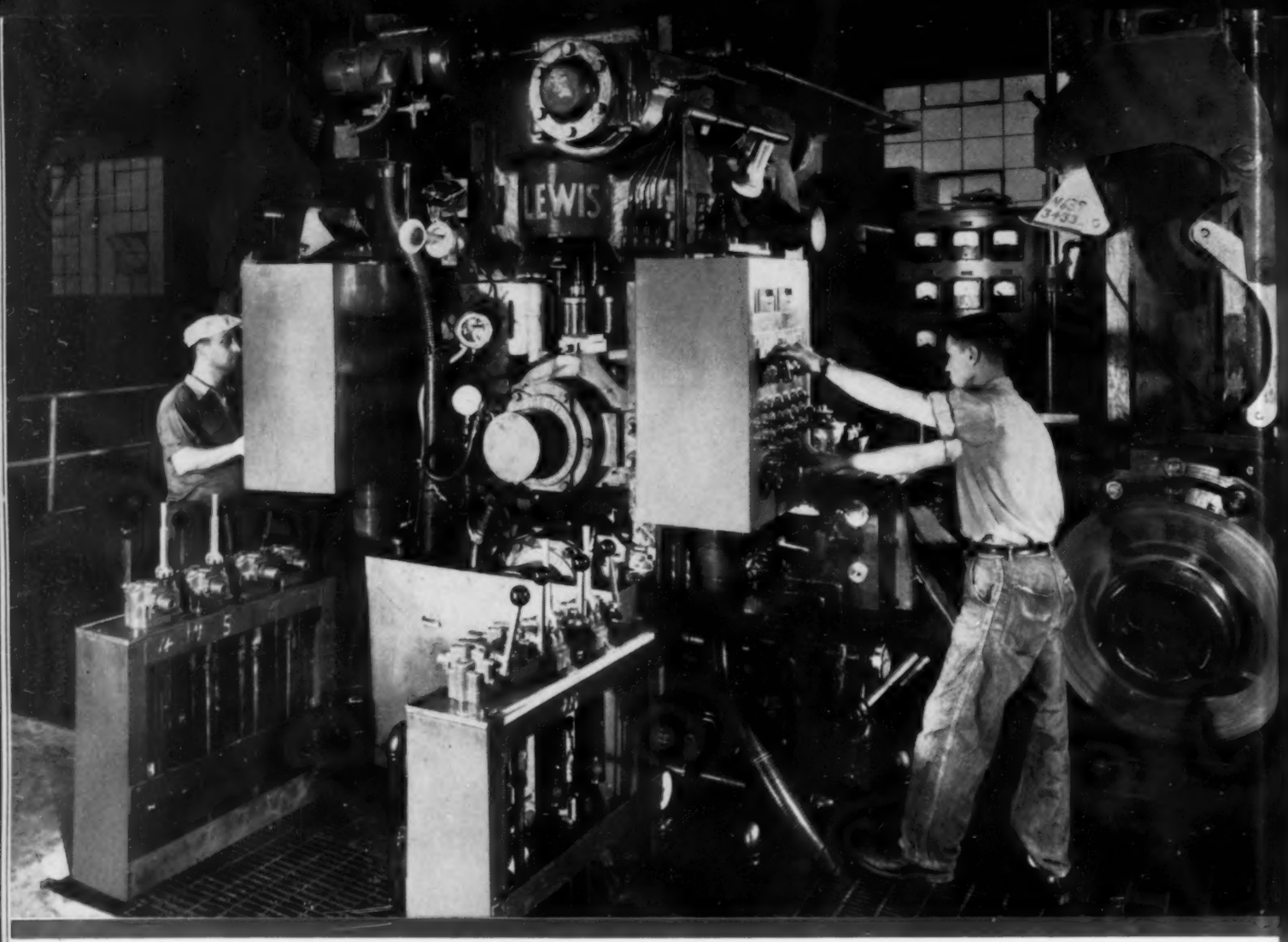

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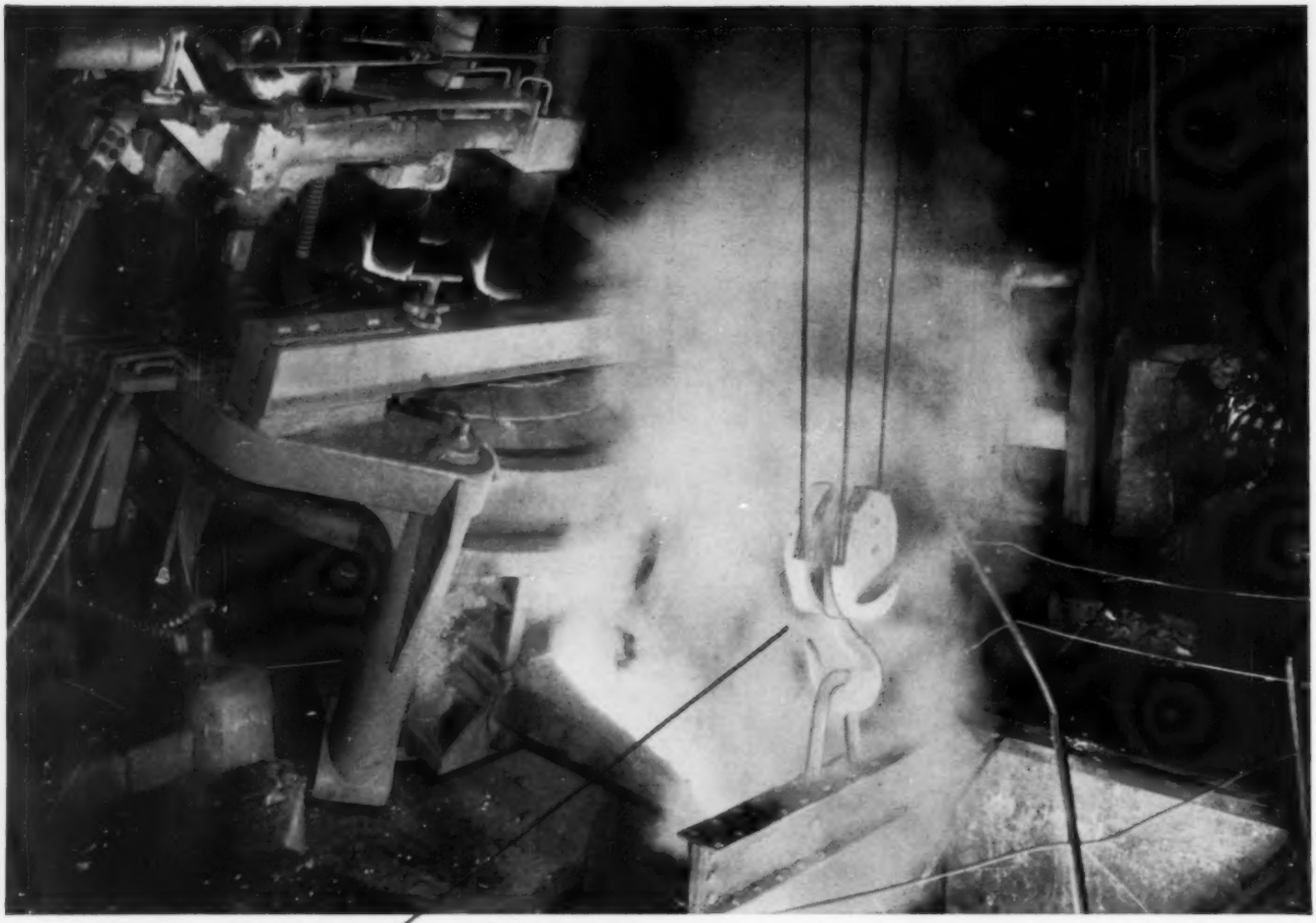

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WHEN YOU MELT... MOORE RAPID *Lectromelt*

MODERNIZATION of ROD MILL at Steel Company of Canada

By D. W. McLEAN
Assistant Superintendent
Rod and Bar Mill
Steel Co. of Canada, Ltd.
Hamilton, Ontario, Canada

. . . . both operating as well as technical problems were successfully solved in converting this rod mill from two to three-strand operations . . . .

▲ THIS paper covers the remodeling of a two-strand, 16-stand rod mill, built in 1913, to a 20-stand, three-strand mill. It must be appreciated that this mill was the sole supplier to several wire mills and hence any conversion must be accomplished in a minimum of down time. The objective was an increase in rod production of at least 10 per cent and improvements which had been made on the old set-up (Figure 1) were giving about 23.7 tons per hour as an average. By using a long repeater after the first ten stands, the last six were running almost three strands at about 3200 fpm on No. 5 rod. At the outset certain physical limitations were

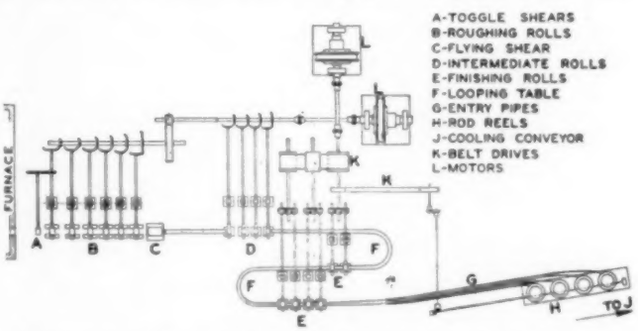


Figure 1 — Sketch shows rod mill before remodeling.

evident. The mill must fit between the existing conveyor and the existing furnace which incidentally was rated at 25 tons per hr. The mill was also located between two other buildings and hence no widening could be done.

It was finally decided that a 20-stand mill with four motors and adequate speed ranges on each motor would give the desired results and fit within the space available (see Figure 2); it was also felt that four laying reels would give ample capacity for coiling and possibly two pouring reels for heavier sizes, this was later changed to three pouring reels.

A general survey indicated that the billet yard capacity about 10 to 12,000 tons would be adequate and billet size being changed from 1¾ to 2 in., thereby increasing the weight from 300 to 400 lb, would not present too many difficulties; next the furnace—25 tons per hr—would not be adequate and remodeling of the furnace could be done prior to the general shutdown. This was done by removing the pipe style recuperators and adding new burners to use either gas or fuel oil plus the necessary air fans, damper control, fuel regulation, etc. This in turn permitted the removal of three gas producers and auxiliary equipment and resulted in the furnace capacity rising to approximately 35 tons per hr average, with peaks going to about 40 tons per hr.

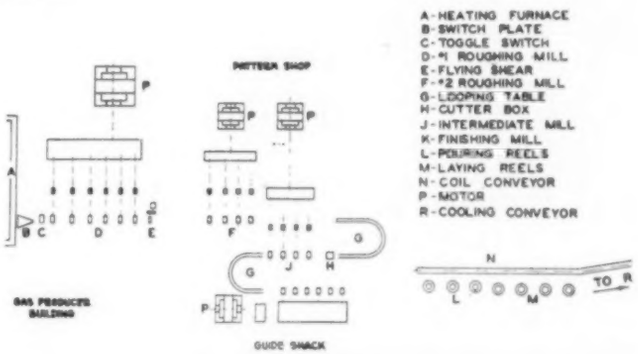


Figure 2 — Sketch shows rod mill after rebuilding.

A charging car was next added, permitting 3 billets to be charged simultaneously, the car returning for a new charge while the pusher was operating; this resulted in the demand on charging skid operation becoming continuous rather than batch style; in other words we now could get the billets into the furnace fast enough to make use of the added heating capacity.

Mill cobbles have always been a problem in this rod mill as in most others, so cutter boxes, (Figure 3) operated with air thrusters through solenoids and activated with an electric eye set-up were installed on the old mill. These, after a few months, resulted in only about ⅓ of the cobbled billet ending up as cobble in the finishing stand, the next third was taken out at No. 1

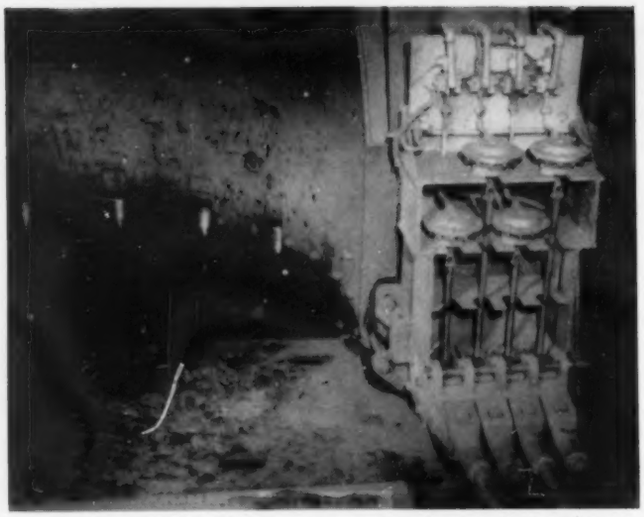


Figure 3 — The mill has cutter boxes operated with air thrusters.

repeater and the balance went down the cobble pipe under No. 7 stand.

A special Stelco design of roller thrust bearings was tried out on the finishing mills — this necessitated changes in the housings and mill rolls and this was tried on three housings, No. 16, No. 14 and No. 11. Changes such as new type bearings, lubrication method, etc., were made. Work then commenced on converting all housings to accommodate this design and the new housings which were being ordered for the finishing group were specified to include this feature. When the new mill was installed, the mills from No. 1 to 20 were equipped with these bearings, rolls ordered to suit and not without some misgivings; happily, as it turned out, very little difficulty was experienced.

The old style solid spindles were supplanted in the finishing mills with double XH pipe spindles with manganese steel wobbler ends welded on to mesh into boxes of the same material. This reduced the labor involved in roll changes due to lighter weight of spindles and was incorporated on the last 14 stands of the new mill.

While these improvements were going on and the minor details were ironed out, the design of the new mill was going forward and plans for the actual scheduling of construction were being formulated. Some excavation could be done, some foundations poured and some electrical construction be done with a bit of inconvenience but without shutting down. Furthermore, by increased schedules plus the improvements already made, rod to the extent of a six weeks supply could be stock piled ahead of the wire mills, about 20,000 tons in total.

The first move was to appropriate the south end of the pattern shop—this meant relocating a carpenter shop and moving the pattern shop office and washrooms to the north end. This being completed, digging commenced for the power house cellars, oil cellars, and extended out into the mill right up to the bevel gear drives and the two drive motors. The guide shack was relocated taking up some of the old gas producer space and thus the foundation for the finishing mill motor could be installed. Everything possible having been completed and the mill still running, it was now a matter of awaiting delivery of equipment and filling the stock pile, no further move would be made until all the equipment was on location and assembled as far as possible and still not be too heavy for the cranes. An additional overhead crane was installed, having been taken from another runway where it was no longer a necessity, and was to be used for the construction period only; it is still in service in the mill.

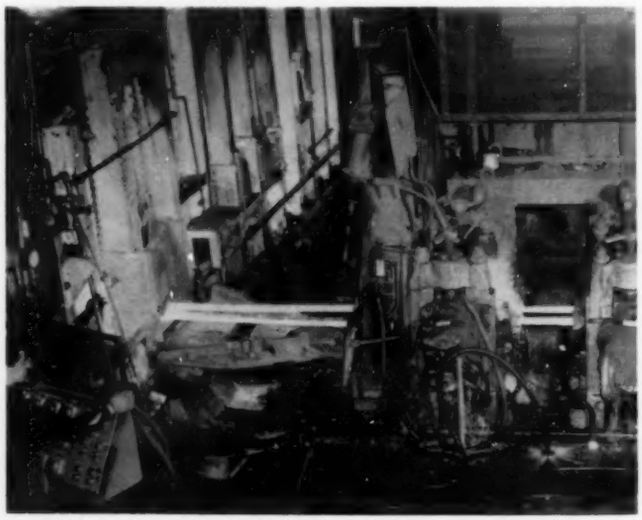
On October 23, 1952, the big day arrived and within twenty-four hours of shutting down, the entire mill—drives, mills, reels, etc., had been removed by the mechanical department to make way for the excavators and foundation workers. The mill was loaded into open railway cars and unloaded out in the open, the thinking being that any equipment to be re-used would go from the outside area rather than the mill for any necessary alterations. This resulted in reducing confusion within the mill building and also accelerated the locating of any equipment so required. Motors were similarly treated and shipped out for repairs and alterations.

The entire area not already excavated was then excavated and repoured to the new design, provisions being made for scale sewers, pipe trenches, oil supplies and electric conduit. Great credit is due to the construction supervisors and engineers who put up with innumerable requests from the supervisors of the various phases of the work in their attempts to get their part of the job completed first, and as the work was round-the-clock, seven days a week, there were plenty of problems.

However, after a few weeks of struggle; labor difficulties and a lot of hard work, new foundations began to appear and equipment was installed; the mill was ready to turn over on November 27, the conversion having been completed in five weeks.

The two original 1600-hp motors had been relocated, one to drive the first six mills, the other, the last six. Two additional 1000-hp motors had been added to drive the second rougher and intermediate stands. Rotating regulator controls had been installed on the generators, thus eliminating the need for a power house operator who formerly controlled loops, motor voltages, etc., with selector switches and rheostats. Generators for the reel motors had been installed and all the panel board and control panels necessary for mill

Figure 4 — A control panel was installed in the new mill with push button control.



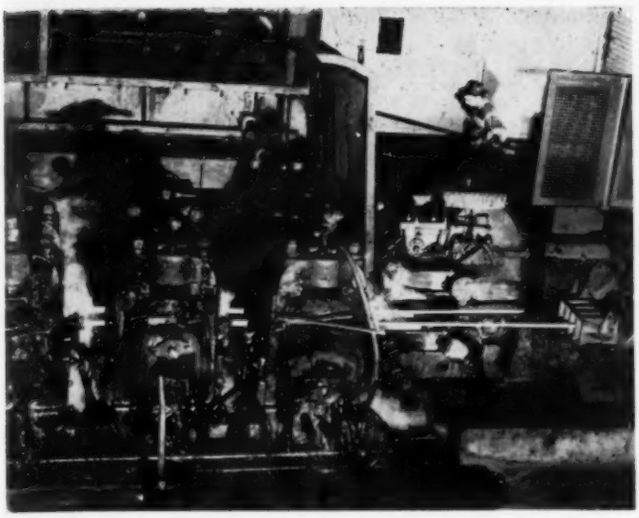


Figure 5 — An electrically operated flying shear was used to replace the steam unit.

motor and reel motor control was in place out in the mill where the roller could control it.

An entirely new pass design had been evolved, new guides, etc. The training of operators, along with changes in equipment now began. In this phase of the change-over, there were some errors. For example, the furnace operator or whistle man who blows the bars into No. 1, formerly had a few air cylinders operated with on-off air valves controlling two strands. In the new layout, an electrically driven switch plate (Figure 4) with four working positions and a fifth "in the clear position" now became five push buttons on a control panel. In addition the plate could be raised or lowered in any position—two more buttons. The billet shear now had four separately operated knives—four more buttons. There was a water line valve, solenoid controlled, on each pass for cooling purposes—four more buttons plus his old whistle which, to be in keeping with the control panel, could no longer be a simple pull chord, but was now a solenoid controlled air valve set-up and hence another button. The old operation of two air valves and a couple of hand levers had now become a swing away type operating panel equipped with a dozen push buttons and the operators would at first often pick the wrong button.

Figure 6 — These old pouring reels were rebuilt to fit in with the new mill.

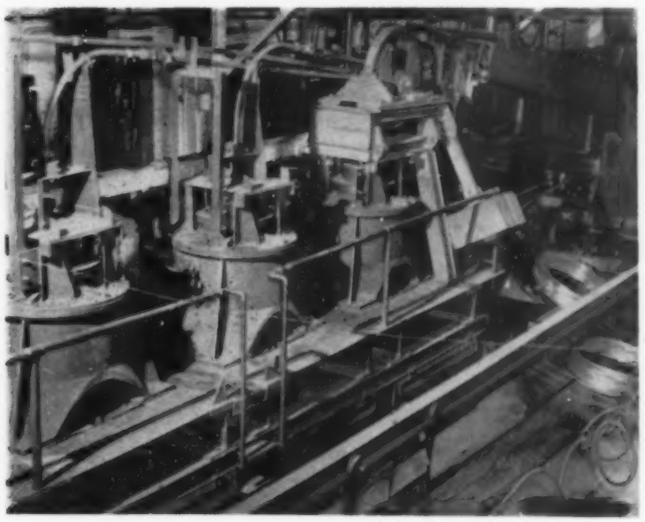
The flying shear, formerly a steam type tripped with one simple steam valve and followed by two switch pipes, which were moved to two locations with an air operated jumper mechanism, the pipes being turned down manually in the case of cobbles or loops now became an electrically operated flying shear. This shear (Figure 5) could be moved to the four separate passes and due to there being eight passes in No. 6 mill, it has two separate sets of four positions depending on which set of passes is in use. Following the shear are four pipes rotated by air cylinders moving racks which mesh with gears on the pipes—solenoid valves of course, and push button controls eight of them. This constituted enough controls to warrant a control station. In passing it might be mentioned that this shear and guide pipe arrangement has worked out very well and now gives little trouble.

Similar conditions were encountered at the reel hole (Figures 6 and 7) where the old pouring reels had been revamped and the laying reels added so that instead of four levers and a few valves we now find an air conditioned pulpit with a specialist in charge.

The problem now was to convince the operators that the new set-up was much simpler than the old, that more tonnage and hence higher wages were possible, and that it was not any hotter with three and a half to four strands running through the mill than it was before with two and lastly, to allow time for them to get the "feel" of the new controls.

It would be a long story to recount all the incidents and difficulties encountered; I would like, however, to emphasize that many times people whom we were ready to fire for being so stupid finally developed into

Figure 7 — Laying reels were added to the mill.



what we think are good operators, which just shows how wrong one can be in his opinions.

Naturally with the new equipment, some changes soon became obviously necessary on the mechanical and electrical equipment. A description of a few of these might be interesting.

The iron roughing mill guides, due probably, to the new billet size and pass design, no longer had any worthwhile life and considerable time was lost through worn and broken guides. Stainless steel solved that problem and more than justified the additional cost.

The repeaters had been changed to sloped wall type from the straight wall, and of course, had been shortened up so that we are no longer carrying a long loop. The loops seemed to have the nasty habit of jumping out and back into the grooves and often as not their own groove which confused the bars following it and resulted in cobbles. Triggers were designed which allowed the loop out, but prevented its return; also loops were pulling up on the wall and a series of rollers were installed to prevent marking; on number two repeater, a speed control was installed in the wall to regulate the finishing mill motor speed and prevent pull around this repeater. Back end slap and knots were successfully controlled by a series of low walls in the repeater floor and catch pipe along the side.

The larger bundles, produced from the larger billets,

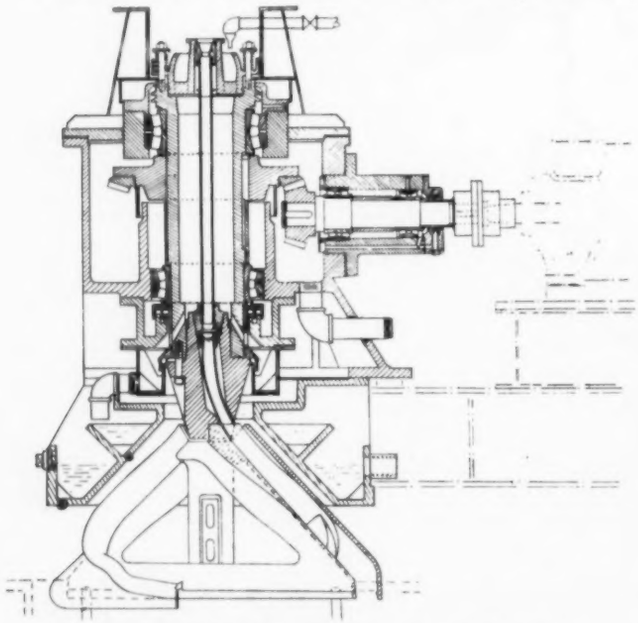


Figure 8 — Sketch shows section of laying reel.

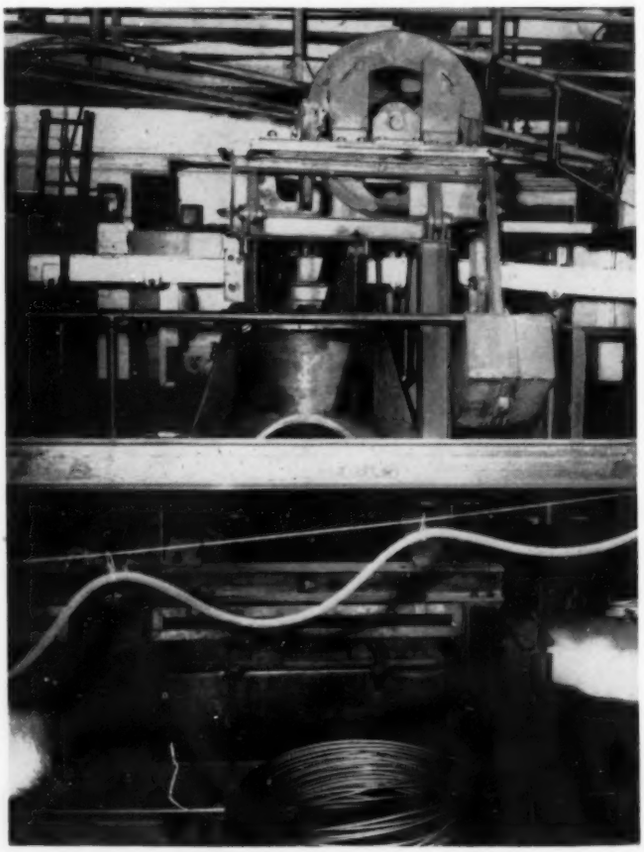
stayed hot longer and in addition to making the trimmers and bundlers work hotter resulted in higher pickling costs.

A high pressure water pump, which had been installed with the mill, was now put to work feeding descalers at the delivery end of the mill. These of course had to be automatically controlled and so the electric eyes which operated the cutter boxes, mentioned previously, were given an extra duty. The operation then became as follows on each of the four passes; a bar leaving No. 10 activated an eye which set a time relay to work, a second eye at number 20, if the bar reached there, shut the timer off and turned the water on. If, however, the bar did not reach No. 20, the timer was not shut off and it caused the cutter to work since the bar had cobbled and the water did not come on. All this was developed by trial and error after it was found that the front ends did not appear able to enter a pipe full of 100-psi water without cobbling. It obviously took some time and thought plus a lot of work for the electrical people. Rod coiling temperatures of less than 1400 F have been obtained with these descalers.

Another added starter was a method of introducing air into these descalers to force the water out in the event of a reel cobble, since it was found that spring steels would break up into short pieces under these conditions and fill the pipes leading into the reels solid. This was done by slotting the delivery pipe so that the bar buckling was seen by an eye which shut the water off and turned the air on, the reel operator then pushes a button to keep the water off on the cobbled bars, the others return to normal in three seconds.

The laying reels were a bit of a problem too. The original construction of bell mouths and variously shaped pipes were altered considerably. See Figures 8 and 9. The straight vertical pipe warped even though water cooled and this was ribbed and made of ordinary pipe rather than stainless steel. The short curved pipe was eliminated and a full length pipe bent somewhat like a pretzel was installed. A skirt was added to the bottom of the spinner, because the back ends sometimes clung to the spinner and went over the spokes causing cobble around the spinner. The tubs and platens in the reels became greatly overheated, cracked, seized up and due to our attempts to coil rods up to and including ½ in. in the laying reels, the spokes took a beating. These problems were slowly overcome, ending up with solid centers replacing the spokes, plus

Figure 9 — No. 4 laying reel.



wheels at the top of the reels to reduce the pull around the curve after the bar has left the mill. Also, reel speed regulators located in the pulpit, plus a set of calculated reel speeds for each size of rod produced materially improved the operation.

The pushers and basket motion of the laying reels is hydraulically operated using oil for the fluid. Considerable trouble was experienced with hydraulic leaks and due to the extreme heat of the equipment, fire was a hazard. Plans are at present under way to take care of this problem.

The mill rolls sizes from No. 5 rods up to ¾-in. round including reinforcing sections plus ⅝-in. spike rod. This is possible due to the use of a special designed hot bed. There is an alternate route from the finishing mill which bypasses the reels and leads directly up to the bed through a trough equipped with friction driven rollers. Due to the billet weight and the hot bed length, up to two cuts per billet are necessary on some sizes. This is done with a Stelco designed rotary flying shear located between the finishing mill and the hot bed. This shear and its operation is an interesting problem which has not been completely overcome as yet but appears very promising, at least, it is very provoking.

It would not be right in a paper on this subject to overlook some of the safety features which were incorporated in the design. The flying shear operator, the furnace operator and the reel operator were all moved from their somewhat hazardous locations on the old mill to a safe distance from the equipment they control; this would not have been possible without the "push buttons." All mill groups except the six roughing stands were totally enclosed with removable cages. These cages are equipped with movable doors mounted on rollers, also large flood lights are installed permanently in the top of the cages so that there is plenty of light on the mills at all times. A signal horn sounds as each new front end comes around No. 1 repeater, thus alerting anyone working on the last ten stands. Some work has been done to reduce the hazardous work of shining passes, namely by experimenting in the use of high speed air tools and burrs for this job. A catwalk has been constructed the full length of the mill proper and permits visitors and others a safe passageway from which to view the operation.

Quality off the new mill is a somewhat controversial issue. Mill operators believe an improvement has been made in this regard and additional provision has been made to inspect and test the product. This takes the form of an additional inspector located at the reel hole who samples back ends off each reel at five minute intervals. These samples are bent into a hairpin shape, rotated through two complete turns and back, then pickled and visually examined under strong light. This reveals laps, cracks, etc., and these along with any variations in size or surface defects are reported to the finisher or assistant roller by this inspector.

The original inspector still checks on the hook conveyor and notifies the mill by means of a teleautograph of size or surface defects which are causing rejects.

A compression machine was installed with which compression tests are made on every fifth bundle of cold heading grades and every tenth bundle of other grades. This, to some extent, establishes the trimming practice which is to be followed.

For bars such as may be produced on the hot bed, the combination of compression testing and magnetic particle test equipment is available in addition to the regular visual inspection.

Hourly temperature readings of rods entering the reels are also taken and serve as a measure of our effectiveness in keeping pickling costs down.

DISCUSSION

PRESENTED BY

F. S. WILKINS, Rod and Wire Mills, Jones and Laughlin Steel Corp., Aliquippa, Pa.

ROGER KINNICUTT, JR., Rolling Mill Engineer, Morgan Construction Co., Worcester, Mass.

D. C. HORSMAN, Assistant General Superintendent, Continental Steel Corp., Kokomo, Ind.

D. W. McLEAN, Assistant Superintendent, Rod and Bar Mills, Steel Co. of Canada, Ltd., Hamilton, Ontario, Canada.

F. S. Wilkins: I would like to ask at what speed you generally run the 0.218 rod? Do you find any difference in your low carbon and high carbon speeds, and do you use a pulpit operator or is all of the adjustments done by the boys down on the floor? Also I would like to know a little bit about the pass shining device that you have—is it for multiple passes or what?

Member: Are you running three strands both roughing and finishing? I would like you to talk a bit about the tapping of the end of the roll. We have never used that.

Roger Kinnicutt, Jr.: I have just two questions which I would like to ask but first the background of the questions might be of interest. The mill about which we have just heard was one of four as nearly identical rod mills as could possibly have been built at one time or within a short space of time. In those days I suppose rod mills could be "taken off the shelf," which certainly is not true or possible today. One of these four mills in in England, two are in this country and, of course, the one we have just heard about in Canada. Of these four mills, two have now been modified by other mill builders. The one in England has been rebuilt once already by us and is undergoing a second modernization program engineered by us. The fourth mill, I believe, is operating just as it was installed some forty years ago. All four mills were originally arranged for two-strand operation. The mill that has not been changed is at present still producing up to 23 tons per hour, the one in England still on two strands is now producing 30 to 32 tons per hour and will go to 37 to 40 tons, the second one in this country is now producing with three strands about 55 tons per hour and with a projected fourth strand might reach 75 tons per hour. These tonnages are based on 0.218 to 0.220-in. rods and the increases mentioned were achieved with relatively minor changes in layout and with an expense surprisingly small compared to the advantages gained. It cannot be overlooked that during the down-time required for rebuilding a mill, the loss of production must be calculated as an expense item and in many cases looms so large as to cancel a modernization program in favor

of bringing in an entirely new mill as the practical answer to the demand for increased production, better quality or lower production conversion cost. The mills we have heard about in this paper and the one preceding it, and three of the four mills mentioned in these remarks, were changed over with a minimum of this costly downtime. After making these comments I would like to put my two questions to the author: What is the delivery speed since the conversion of your rod mill and why was the large loop in the first repeater discarded by this conversion when the desired increased production could have been achieved at far less cost if that loop had been maintained?

D. C. Horsman: I have two questions; the first is on a remark as to the use of stainless steel guides in the roughing mills. Are stainless steel guides used on both entry and delivery sides of the roughing mills?

Second, on the temperature of the bars going into the reels, I want to ask how that is measured, and what temperature or what range of temperatures for different products are maintained?

I would like also to comment on the titanium carbide guides. I believe that the Bethlehem people at Johnstown probably are the best ones to discuss that application. To my knowledge they have probably done more on it than anybody else. It is a very interesting application and one that has a lot of possibilities. We have started some experiments with titanium-carbide just recently, and it looks very promising. Our experiments are not conclusive as yet, but we have attained over 300 hours on the inserts in our finishing pass and are operating at around 4800 fpm. In its first trial, they looked very promising to us—and I know a number of other plants who are trying them out. I would also like to hear further comment on the use of these guides or any other similar hard materials that are being used in finishing mill guides to extend the guide life.

D. W. McLean: On the question of No. 5 rod speeds, when the mill was revamped we were hitting about 3200 fpm on the old set-up, and we are hoping to get 3800 fpm on the new. The electrical superintendent said we are now nibbling up around 4000 fpm. It varies, of course. We changed gears the other day in the finishing, and maybe we are going a little faster than 4000 fpm right now. Mr. Sheridan Smith tells me he is thinking of changing some more over in the rougher, and we may then get a little better than that. We started off with 3800 fpm.

As to the pulpit operator, we eliminated that and the control panel is right down to the floor of our mill. We had a little difficulty at the start getting the motor settled down which gave us trouble in the No. 2 repeater with loops on the back wall. We installed a little pendulum-type device that would contact a switch and slow that finishing motor down, if the loops came in too tight. This was not too much concern on No. 1 repeater but was more serious in its effects when it occurred in No. 2 and hence the controller was installed in No. 2 repeater.

You asked about the pass shining and so on. That is a "pet" of mine with which we have been toying. We just used a small high-speed air tool which is quite common—an air grinder, 20,000 rpm, and then put one of the carbide burrs right to the size of your pass plug in that machine. If the boy doing it just reaches in on the one pass and touches it gently, it will take the shoulders off; on the other hand with the mill turning over if he cocks it sideways, or touches it too hard or cocks it down, it will wreck the burr or the pass. So as I say we are just making an experiment with it and I hope some day we will be able to make it succeed and eliminate the handstone for shining passes. You do that on one pass at a time.

We are set up on four passes—right from No. 1 to No. 20 and we try to keep three bars in the mill at one time. In the illustration of the switchplate, there were only two bars in the mill. We try to keep two in from the furnace right through, or three, rather, and when the boys get anxious they sometimes nibble at a fourth one.

It was mentioned that the ends of the roll were bored and threaded. In the last week or so, on No. 1 we are putting 5 in a set of rolls with the ends cast right on. We realized that was better than what we had, so as we use up the rolls I believe we will go to that style. It is better and it allows you to get in closer than we have been able to get because you do not have to allow the flat section to back the stud out.

Now, the long loop, we abandoned it—it ties in pretty well with the fact that we have four laying reels and three pouring wheels. Now, with two strands probably the best set-up would be to have six laying reels so you would have a choice of two. Our rods do not have that choice. No. 1 goes into No. 1, and No. 4 into 4, 3 into 3 and 2 with 2. Each rod is set on a wheel in the laying set-up. That, tied in with the fact that we did not change our old drag conveyor up through there, and since it runs continuously, means that there is not too much time to get the coils out and be ready before the next one is coming through. If we had a set-up where we could have four bars running through the finisher all the time, we would be doing it. As far as our operators are concerned, they would be wanting that tonnage but we believe our reels may not have time to clear and match the speed of the conveyor.

We have stainless steel guides all through the roughing. The temperature of the rods in the reels is taken with the optical pyrometer at the hottest part of the coil after they are coiled—not as they are going into the reels. We are making every effort to get down to 1450 F with the water, and with some success.

As far as temperatures we coil, we do have a range from say 1425 up to 1600 F. If we go above that, the works manager hears all about it, and we have to get busy and get down. We would like to get them down still lower to see if we can improve the drawing practice at the wire mill.

Referring to Figure 2, our cage is completely enclosed. We built cages by putting four spuds in each corner of the group and solid wire screen around these sides. At the front you have two or three, or whatever you need, sets of tracks, so that doors are mounted on the inside track with rollers; others on the middle, for the outside. You can slide a screen door out and get into work at that mill and still have coverage on that mill for the people out here. Now, a man going in, he

has no more protection than ever, except that he does not go in when the front end is coming toward him. Of course the buzzer warns the man that has his back to the mill of the arrival of the new front end at this point. The time for the bars to get to him gives him time to get out and abandon his job or else finish it and get out in time.

As to the speed of the mill on the heavies, coiling speed on the 0.531-in. is such that the reels run about 120 rpm and the finishing roll motor runs around 200. Normally that finishing mill on No. 5 rod runs about 580 on the motor. That will give a proportionate picture. At 580 rpm we are finishing around 4000 fpm and on the 0.531-in. we are running about 200 rpm. That was a little too slow.

We believe we are going to be successful with these reels of ours in coiling up to ½ in.

Now, on the straightening of the concrete bars we coil the ½-in., but do not attempt to coil the ⅝-in. on that mill as yet for straightening reasons.

MAGNETIC AMPLIFIER PROVES ITSELF IN STEEL MILL SERVICE

By J. W. BRINKS
Steel Mill Engineer
Westinghouse Electric Corp.
E. Pittsburgh, Pa.

▲ SUCCESSFUL operation since March of 1954 has served as final proof of the place the magnetic amplifier has earned for itself in tandem cold-strip mill regulator applications. Pittsburgh Steel's new 66-in., four-stand, 3190-fpm tandem mill is equipped with 400-cycle magnetic amplifier regulators to control the voltage of the stand supply generators and the current and counter-emf of the winding reel.

The improvement in performance of this mill as compared to that of previously installed mills using rotating regulator control was forecast as the result of full scale tests conducted at our East Pittsburgh plant in 1951. These tests were carried out with a 3600-kw generator and a 4000-hp double-armature motor designed for tandem mill service. Many steel plant engineering personnel witnessed this full scale test. With the motor connected, the generator response to a 15-volt error signal at 50-per cent generator voltage was completed in less than 0.1 second with no appreciable overshoot. The high forcing coupled with the fast speed of response of the magnetic amplifier accounts for this rapid recovery. In addition to the fast response to transient conditions, the regulator has very good steady state accuracy.

Many magnetic amplifier applications utilize a 60-cycle power supply system. But the fast response and high accuracy requirements of the tandem mill regulating system led to the development of the 400-cycle regulator, first used on the Pittsburgh Steel mill. Since the response time of a magnetic amplifier to an error signal is inversely proportional to the supply frequency, the advantage of the 400-cycle system can be appreciated readily. The fast response characteristics of the magnetic amplifier also result in a regulating system requiring practically no damping.

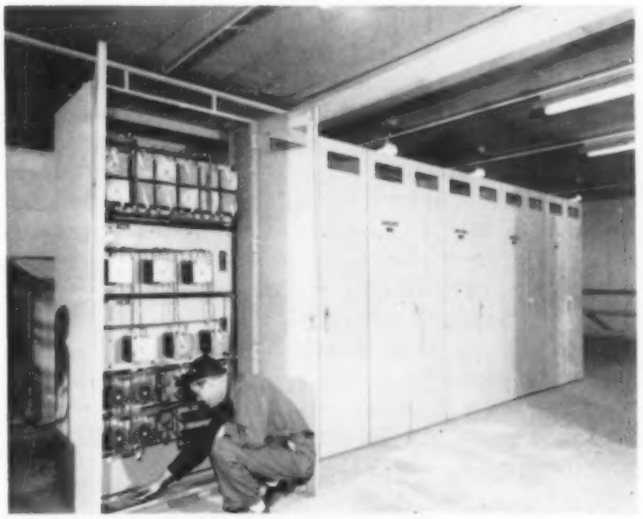


Figure — The magnetic amplifier for the stands, reel and 400-cycle generator are in ventilated steel cabinets.

About two months after these full scale factory tests, Pittsburgh Steel bought electrical equipment for their new four-stand mill. Magnetic amplifier regulators were specified.

Field adjustment tests prior to the mill start-up showed system performance equal to or better than that of the 1951 factory test. Subsequent mill operation to date has demonstrated that the 400-cycle system requires a minimum of maintenance and provides for optimum mill performance under all operating conditions.

MODERN TECHNIQUES of LUBRICATION Applied to Old Mill Equipment

By E. G. WEIMER

Superintendent Primary Mills Maintenance, United States Steel Corp., Youngstown, Ohio

. . . . mechanical methods of applying lubricant have increased dependability and reduced maintenance on old mill equipment . . . .

▲ CONSIDERABLE progress has been made in the last decade in the development of lubrication techniques on new equipment. "Automation" is now a slogan in design rooms throughout the country. The lubrication systems industry can justifiably say that this is "old hat" for them. Over twenty-five years ago these men were preaching the gospel of automatic lubrication, although some engineers and practical men looked with a jaundiced eye at these radical men who proposed to provide machine methods to supplement the old tallow pot and squirt can.

Designers of precision equipment were quick to realize the possibilities in design refinement available through the use of improved lubrication techniques. In the steel industry, the development of long life precision equipment can be dated back to the time when force feed automatic lubrication became available to the equipment designer. Designers of the steel industry adopted many advancements and inaugurated the use of roller bearing tables, precision mills, high speed shears and the other necessary equipment for fast modern mills.

This period was a banner one for the manufacturer of new equipment and for those fortunate mills where it was installed, but competitively it made rough going for the operators of those mills with old babbitt bearings, the tallow-lubricated antiques. If, indeed, there was to be competition, it was necessary for the old mill to take on the appearance of a modern unit, shedding the obsolete cast tooth pinion, open type gearing and hand lubricating methods.

The primary mills of United States Steel Corp.'s Youngstown District are typical examples of old type equipment. The 43-in. primary mill, built in 1891, is a three-high non-reversing steam-driven bloomer, with necessary lift tables, hydraulic manipulators and related equipment. It is fed from two batteries of pits, consisting of nine rows of regenerative type and one of recuperative type with automatic firing control. The output of the bloomer is fed into one or two of three primary outlets: a 23-in. cross-country small slab and billet mill, a 15-in. continuous billet mill and a four by four-in. bloom outlet.

The 40-in. primary mill, put in operation in 1909, is a two-high, reversing, steam-driven bloomer, fed from seven rows of regenerative type pits, with two of these rows equipped with automatic firing control and forced air. Originally designed to roll a two and a half ton ingot into four by four-in. blooms, the operators of this mill found it necessary to change operating techniques and product to satisfy consumer demands. At present, the mill rolls a 9½-ton ingot into various size slabs, up to six by 38-in., with no major equipment change or addition.

Both mills were equipped with babbitted bearings, cast tooth pinions, hydraulic manipulators, two-piece roll and pinion housings, and other equipment modern in the day of the steam engine. To keep these running, maintenance personnel were well supplied with grease swabs, oil cans, dippers and a generous supply of spares. The supervisor had to contend with the problems of obsolescent equipment on one hand and the resultant safety hazards on the other.

Faced with these problems, the maintenance man had a tremendous task, and a sound starting point had to be found. Arrangements were made for the installation of our first automatic lubrication system in 1933, on the 43-in. mill lift table and counterweight mechanism.

After this initial installation there was a period dur-

ing which little progress was made on further automation of lubrication of these mills. It was after the war production period before the program was reactivated.

To get immediate results, and to reduce one of the major sources of maintenance delay and replacement cost, the 43-in. blooming mill pinions were selected as the first installation in this program. Minor design changes were necessary in the bearing box, and the two-piece pinion housing required remodeling to simulate a one-piece housing with bath type tooth lubrication. With the housings checked against leaks and the reservoir filled to the proper level, proper tooth lubrication on the pinions was insured. Periodically, through the use of the automatic lubrication system, the reservoir supply was replenished as needed. The change prolonged pinion service and reduced grease consumption. This changeover in housings and the installation of automatic lubrication system was carried on to the pinion drives throughout the 23-in. and 15-in. mills.

In 1947 the original automatic lubrication installation of 1933 on the lift table was replaced, and the old system was rebuilt and installed on the 40-in. blooming mill feed table, where it gave trouble-free service until replaced in 1953.

Extended, trouble-free bearing life on the 43-in. blooming mill pinions after lubrication improvements brought thoughts of converting pinion bearings from babbitt to bronze to further improve operating span. In 1949, a set of pinions fitted with bronze bearings was installed. It was a quiet start-up; the normal rumble could be heard only faintly. All seemed well for the first two hours, but due to tight clearances, heat was being generated at all six journals. Three fire hoses were necessary for cooling to keep the mill operating for the first six hours. It then became necessary to change the pinion assembly and reinstall a set with babbitt bearings. Upon dismantling the pinions, it was found that the intense heat generated from improper clearances had scored the journals, and complete reconditioning of pinion necks was required.

In spite of this unfortunate experience, on the next pinion change another set of pinions equipped with bronze bearings was installed. The experience gained from this installation was profitable, and with minor changes we have installed bronze bearings and forged cut-tooth pinions on all drives. The present set on the 43-in. mill was installed in December, 1951. Tonnage on these pinions is well in excess of 3,200,000 and the set is still quite serviceable.

With primary mill pinion problems a thing of the past, and with the realization of the possibilities of automatic lubrication, the project of modernizing the old method of lubricating blooming mill roll necks was undertaken. This required the development of ideas on how to replace that familiar block of roll grease (Figure 1) that had lubricated roll necks for some fifty-odd years. A logical solution seemed to be a hard wooden block similar in size and shape to the block of grease (Figure 2). Hollow in its shape, packed with woolen waste, spring loaded and connected into an automatic lubrication system, the wooden block was inserted in place of the block of grease. To provide lubrication insurance for such a radical change, the roll bearing was drilled and grease grooves were cut for added application of grease through the bearing. This application of automatic lubrication was installed on the 43-in. mill in 1947, and proved so successful that the method was extended until all roll trains on the 23-in. and 15-in. mills were similarly equipped in 1953.

Through close cooperation with designers of automatic lubrication systems, the spray or nozzle method of applying lubricant by injection through an air stream was developed. The method looked good, and an assembly was built up and installed on the 15-in. continuous mill main drive gearing in 1951. With this

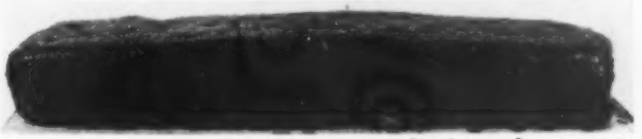


Figure 1 — Roll necks were lubricated for many years with a block of roll grease.

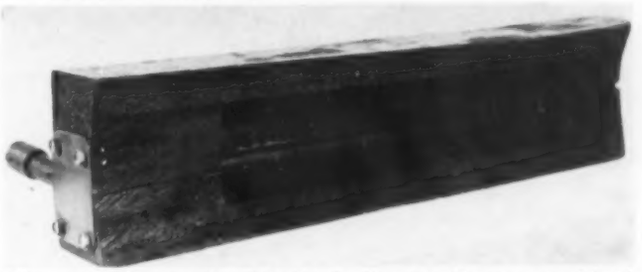


Figure 2 — A wooden block similar to the grease block was the first step in the design of an automatic lubrication system.

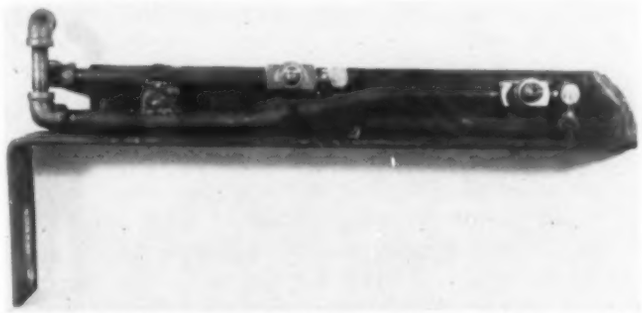


Figure 3 — A spray, consisting of a two-nozzle assembly, has replaced the grease block on roll necks.

Figure 4 — Spray nozzle assembly of Figure 3 has given excellent service.

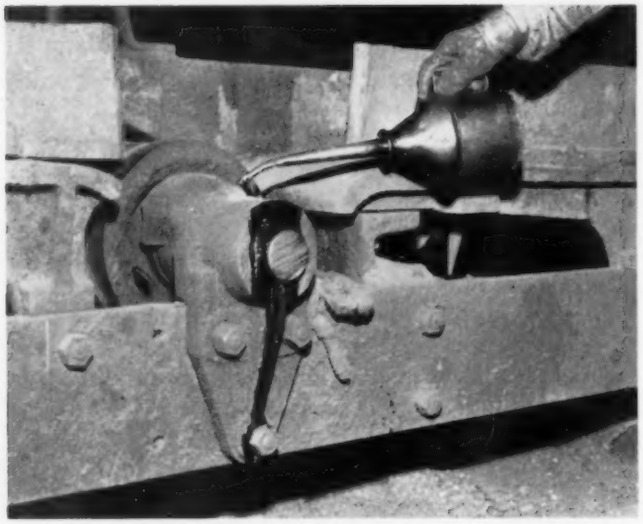


Figure 5 — Older designs for table roll used babbitt bearings.

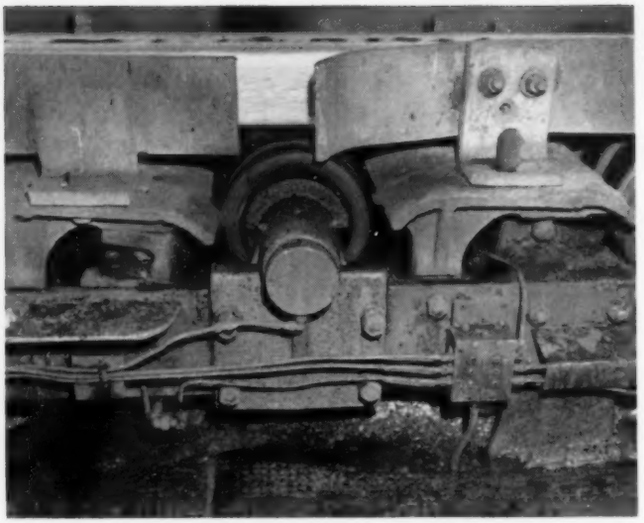


Figure 6 — This table roll bearing design, consisting of a cast steel housing with bronze bushing, has reduced maintenance cost.

type of applicator, it was possible to lubricate journals and gearing from one central lubrication system. Proven satisfactory by its low maintenance cost and ability to apply extreme pressure oils to a work surface, this unorthodox method of lubricating roll necks was developed fully in 1952.

Meanwhile, the wooden block method in use at the 43-in. mill had been installed at the 40-in. mill. However, since that mill was greatly overloaded due to increased ingot size, the results were no better than with the conventional block grease method. Visual inspection of the roll necks during operations showed that, due to tremendous pressure, the necks were being wiped clean of any lubricant film. It was then decided to spray the lubricant on the neck by the method used on the 15-in. continuous mill main drive. An assembly (Figure 3) consisting of two nozzles per unit per roll neck was installed in place of the grease block (Figure 4). With the proper combination of lubricant, spray nozzle and pump timing, the system is the best method known to date in lubricating the open type babbitt bearing. As a further development, roll train grease was discontinued and replaced with an extreme pressure oil and consumption was cut 50 per cent. Bearing life has been doubled, and maintenance simplified. In addition, the air spray method caused a reduction in shop hours by eliminating all drilling and chipping of grease grooves. This system, installed on the 40-in. mill in February, 1952, was installed on the 43-in. mill in March, 1954, with the same gratifying results.

After the installation of the lubrication system on the 43-in. blooming mill pinions in 1946, the remainder of the mill equipment presented a great problem. A study of delays and maintenance costs was made for each of the various tables, and a comprehensive program of automatic lubrication was initiated, with the first installation, consisting of one complete mill table, completed in 1947. This installation has grown until over 500 bearings are now being lubricated from one central pump system. The program has been very successful. The 40-in. mill is 80 per cent completed and the 43-in. mill and its primary outlets are 60 per cent completed.

Through the cooperation of primary mill personnel, numerous ideas in lubrication techniques have been

Figure 7 — The cast iron gearshield on the older units has now been redesigned.

Figure 8 — Oil bath type units have increased the life of table roll gears.

adopted and have helped to make the program a success. Redesign of the original table roll bearing bracket with its babbitt bearing (Figure 5) to the modern cast steel housing (Figure 6) with its bronze bushing has greatly reduced maintenance cost. Some of the original installations of 1947 are still in service.

Redesign of the cast iron gearshield to the present oil bath type fabrication (Figures 7 and 8) has greatly increased the life of table roll gearing, and injection of lubricants into hydraulic systems has increased the life of spools and leathers on manipulator and shear drives. The knowledge gained with each change aided in making further changes. Some installations, however, taught us that automatic lubrication was not always the complete answer. Due to design of equipment and operating procedures, it was necessary to go to oilless graphite impregnated bearings to get results in certain locations.

The application of automatic lubrication to old mills present a problem in choosing a location to house each unit with its pumps, pressure gages, timers and main feeders. By removing and relocating some auxiliary equipment of the mill, it was possible to locate all of the lubrication equipment for the 40-in. mill in one room. Three rooms such as shown in Figure 9 were required for the 43-in. mill and its primary outlets, with one more being considered for the cooling bed facilities.

It was only through these installations and modernization of lubricating techniques that both mills were able to operate at twenty-turn per week levels through the high production years of 1951-1953. Automation in lubrication played a vital role in decreasing maintenance costs and reducing mill delays. It is also felt that by removing maintenance personnel from the hazardous positions necessary to lubricate rolling equipment, automation has helped to achieve the low accident frequency rate we now enjoy.

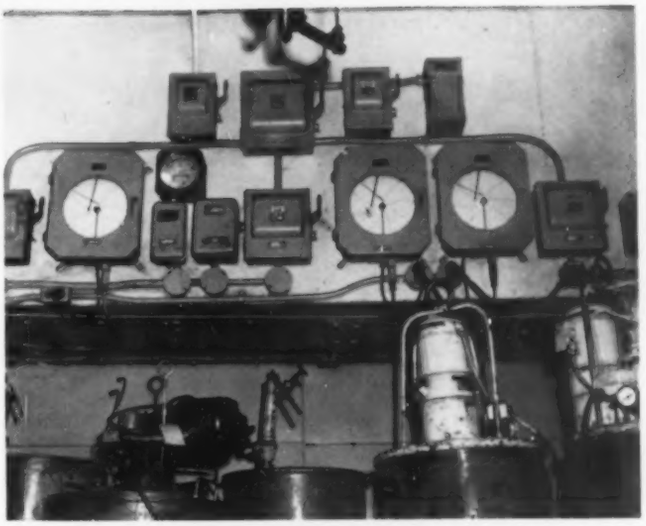


Figure 9 — It is very desirable to locate lubrication equipment in central locations.

Maintenance and proper inspection are, of course, prime requisites in order to promote the continued success of such a program. Personnel must be carefully chosen for this type of work. With the aid of the division of training, a course of study on automatic lubrication systems was prepared, and all maintenance personnel were required to attend. Periodically, a refresher course is given concerning safety and operating problems of specific installations.

It has been shown conclusively that, although basic mill equipment may be obsolete, performance can be held at a competitive level through consistant adaptation of new developments. Through the concentrated efforts of all concerned, our program to date has been very successful, and we are convinced that further success is attainable through continued application of automation to lubricating techniques.

AISE SPRING CONFERENCE

APRIL 25, 26, 27, 1955

HOTEL STATLER DETROIT, MICH.

By H. S. SPITZ*, Chief Engineer, United States Steel Corp., Fairless Hills, Pa.

Water Processing at Fairless Works

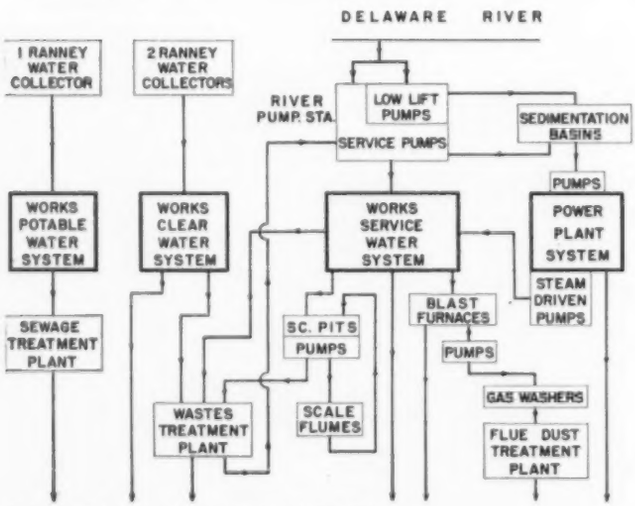
. . . . water processing system at Fairless has been designed for dependable and automatic operation and water quality . . . .

▲ WATER is vitally necessary to steel plant operation as a cooling medium, a solvent for special processes, a cleansing agent, for the production of power, the disposal of wastes and as an adjunct to employee welfare. A general diagram showing the flow of water through the plant is shown in Figure 1. Fairless works requires approximately 230,000,000 gal each day for all services. Of this amount, 48,000,000 gal per day are used in conjunction with the production of the various steel products; 38,000,000 gal per day are used for condenser service in blowing blast furnaces and 72,000,000 gal per day in the production of electric power. Nearly 25 miles of steel, cast iron and concrete lines over 6 in. in diameter and a proportionally larger amount of smaller lines are required to supply these services.

Approximately one-third of the total water taken into the works enters the waste treatment system as industrial waste through 43 separate outflows after collecting more than a dozen different chemical compositions and physical types of waste. Figure 2 represents diagrammatically, the flow through all the waste treatment processes. These wastes comprise four acids, two alkalis, three soluble oils, two insoluble types of oil, mill scale and flue dust, which are treated by sedimentation, flocculation, clarification, skimming and neutralization processes. The facilities are arranged for accumulative elimination of impurities. Processes are designed to use component wastes to eliminate other wastes with the final outflow to the river of better quality than the original river water. For convenience in processing, separate treatment plants handle the special wastes at the sheet and tin mills and blast furnaces.

A centrally located area on the river bank, about 2200 ft long by 1400 ft wide, is allocated for water and sewage treatment and pumping facilities. A general view of this area is shown in Figure 3. This arrangement is designed to concentrate in one area most of the water processing facilities in order to obtain an automatic and minimum maintenance installation.

Figure 1 — Flexibility of operations was incorporated in the design of the water supply system at Fairless works.



*Now Chief Engineer Homestead Works.

RIVER PUMPING STATION

Water is pumped from the Delaware River for general service and condenser cooling requirements. Pumping station construction is illustrated by Figure 4. This view shows the station in its eventual form. Physically, it is a reinforced concrete structure, presently 82 by 100 ft, divided into five longitudinal bays and six lateral sections. The cellular construction permits each individual cell to be dewatered for inspection and maintenance. Other than a small control room there is no superstructure, the pumps being designed for outdoor installation. The installed capacity, at average river conditions, of the low lift pumps is 342,000,000 gal per day and of the service water pumps 133,000,000 gal per day. Each of the longitudinal bays are similar, bays 1 to 4 equipped with one full-sized low lift pump and one full-sized service water pump each. Bay No. 5 is equipped with two one-third sized low lift pumps and two one-third sized service pumps.

The station is supplied by two sets of intakes to permit continuous operation during seasonal variations of the river water level. Water normally enters over con-

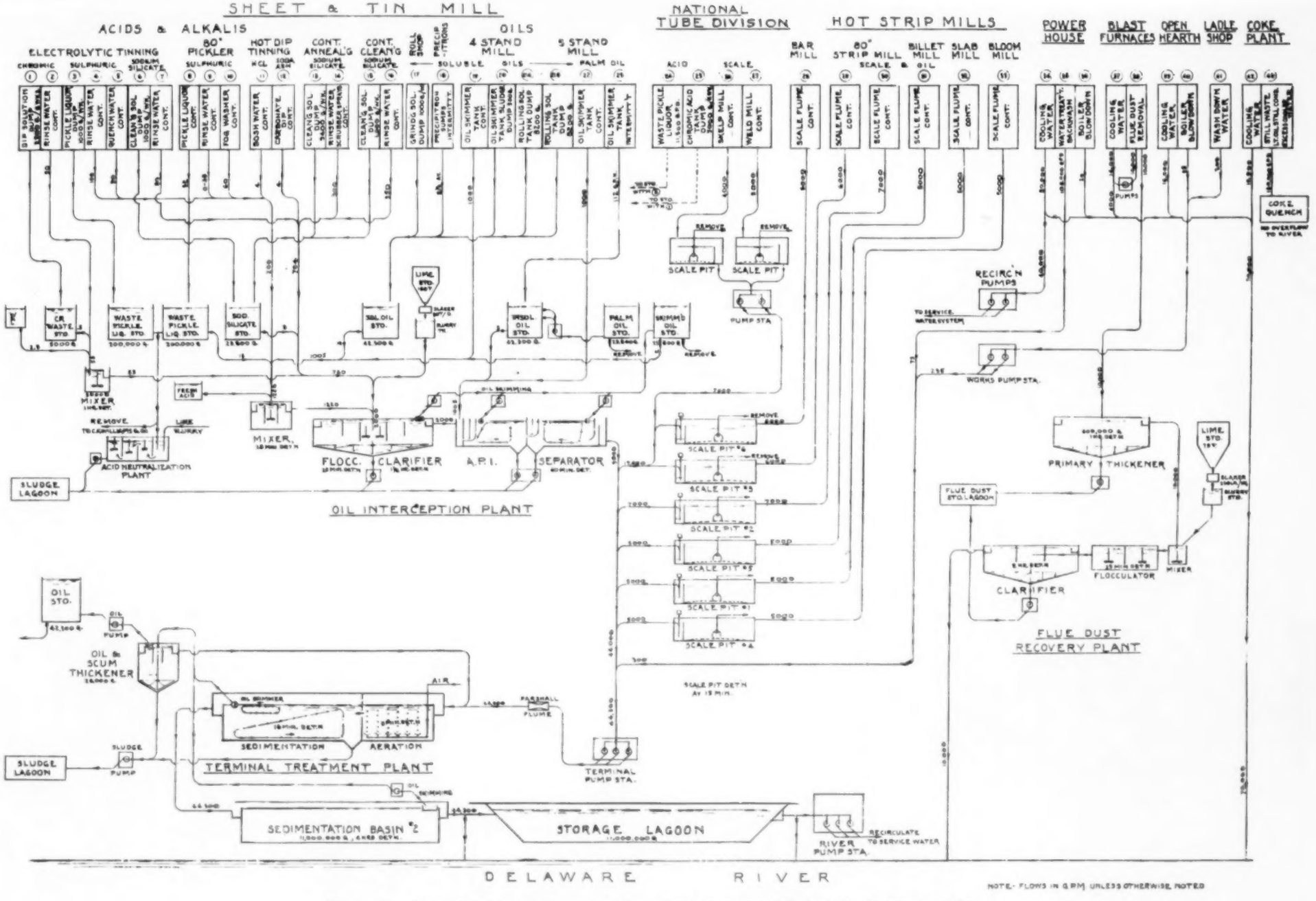


Figure 2 — Several waste treatment system plants were installed at the Fairless works.

Figure 3 — Water and sewage treatment and pumping facilities are concentrated in an area on the river bank.

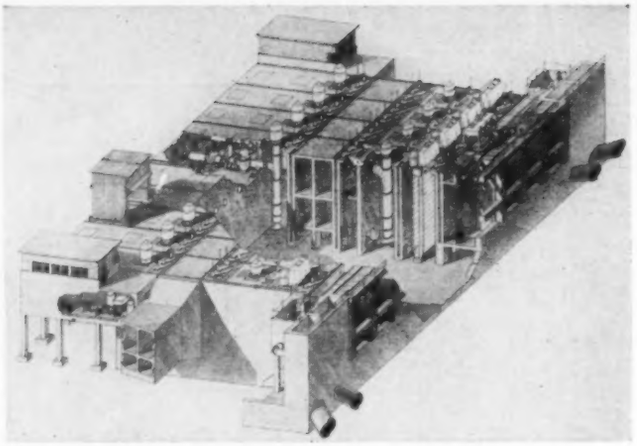
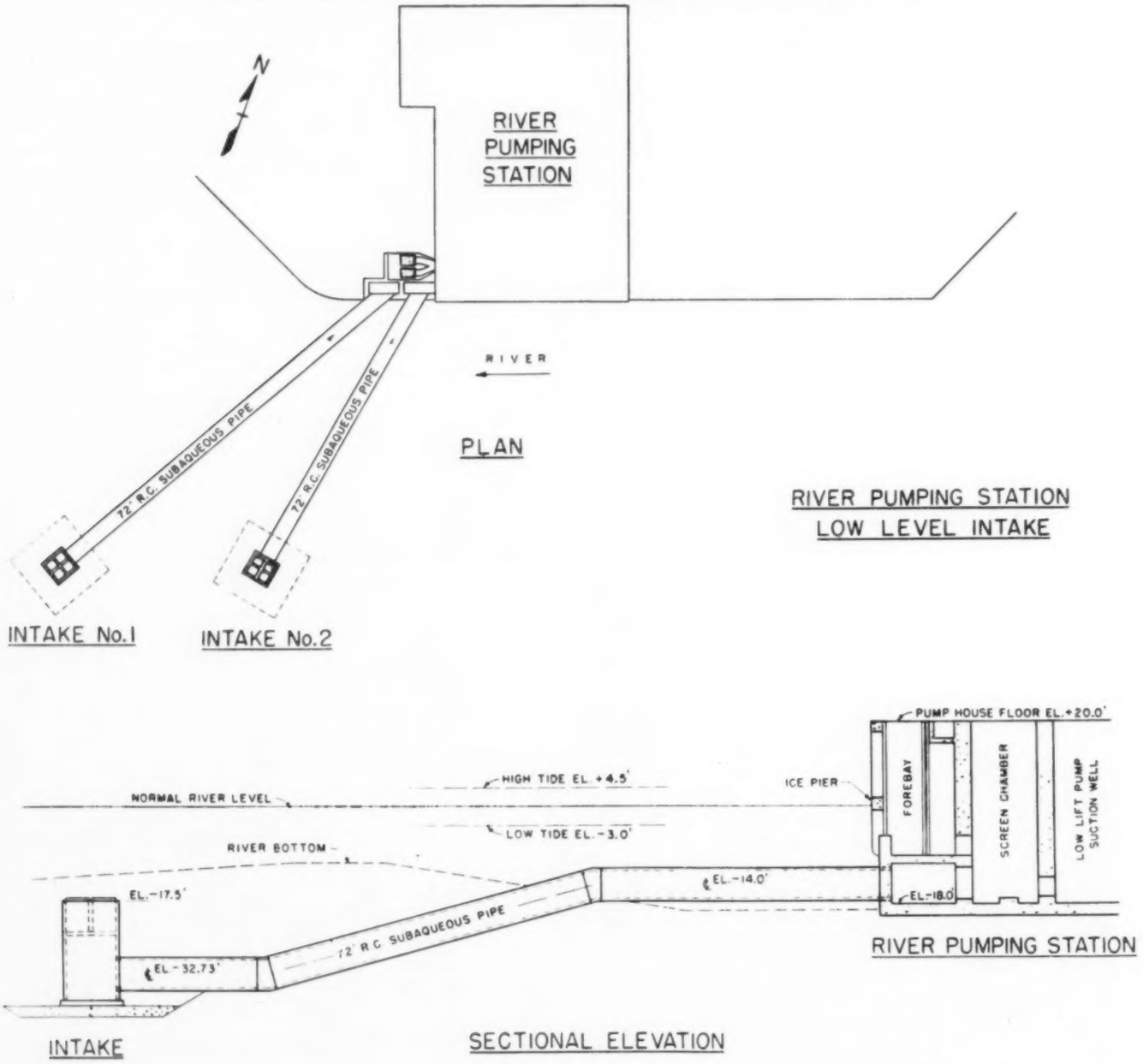


Figure 4 — Section through river pumping station at Fairless works.

crete river bank sills between elevation −5.0 and +7.0. During low water conditions, the low level intakes at elevation −25.0 consisting of two submerged cribs connected by two 72-in. diameter subaqueous concrete pipes to low level intake wells may be used. This arrangement is shown in Figure 5.

Bar racks cleaned by a motorized rake, screen heavy trash from the intake to conventional traveling screens. The 3/8-in. screens are operated only when leaves, grass,

Figure 5 — Two sets of intakes are used depending upon water level conditions.



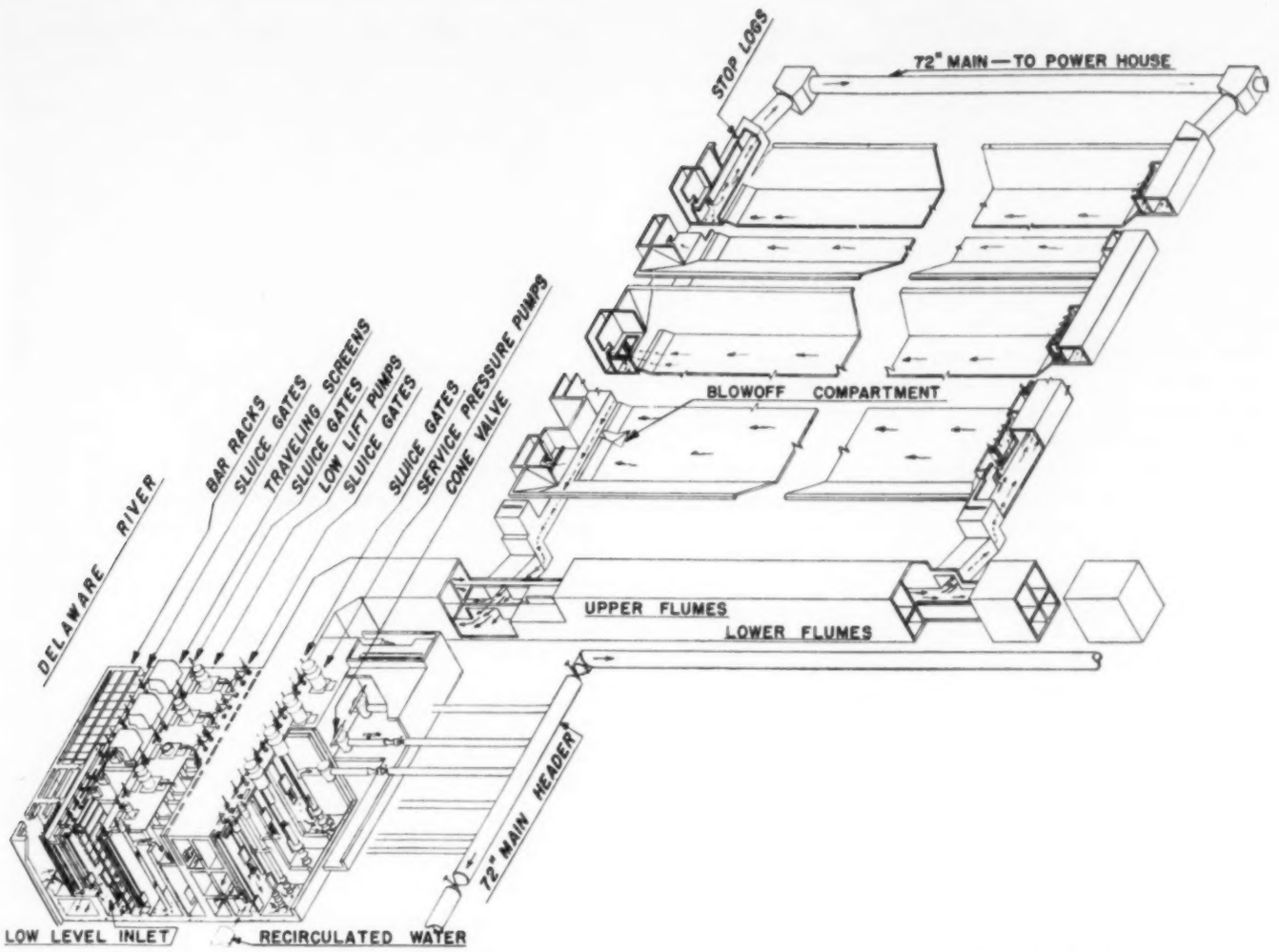


Figure 6 — Schematic shows flow of water through pumping station and sedimentation basins.

algae or fish appear in such quantities as to clog the screens. Screen operation is automatic, controlled by a differential pressure control system which starts the screens when the pressure drop through them exceeds 6 in. The screens are washed by a series of pressure sprays, depositing the accumulated trash in a trash flume which carries it to trash baskets for disposal.

Low lift pumps raise water from the intake wells to the upper levels of a four-barrel flume for delivery to sedimentation basins. Normal operation is automatic and is designed to start and stop the pumps in increments of one-third of a full-sized pump to maintain the level of water in the sedimentation basins at a predetermined level as demand on the system changes.

Full size pumps are 42-in. single-stage propeller type pumps driven by 350-hp, 500-rpm, 2300-volt, squirrel-cage motors, delivering 46,000 gpm against a total head of 20 ft. The third sized pumps are of the same type driven by 150-hp motors, delivering 16,000 gpm. The pumps are controlled by a float operated transmitter, located at the sedimentation basins, electrically connected to an automatic control panel in the central controls building.

The sedimentation basins accomplish two purposes — supplying storage capacity sufficient for approximately one hour retention for the total design flow of the plant to allow suspended solids in the raw river water to settle out, and to provide storage at a level high enough to permit gravity flow to the power station and service water pumps. The flow of water through the pumping station and sedimentation basins is shown by Figure 6. A second sedimentation basin is currently used for waste treatment until water requirements necessitate its use for river water. Each basin is divided into four identical sections which may be dewatered independently for sediment removal and repairs.

Sections are 140 ft wide by 250 ft long and 12.5 ft water depth, giving a total capacity of about 11,000,000 gal per basin. Water enters each basin from the influent flume over distribution weirs, passes through the basin and is decanted under floating weirs to the effluent flume. Sediment is removed by dewatering a section then cleaning by sluicing with hoses and scraping with rubber-tired tractors. Sediment is flushed to an adjacent sludge lagoon from which the accumulated dirt is removed with mobile equipment when necessary.

Approximately half the water passed through the basins flows to the power station for condenser and miscellaneous cooling. The water is pumped through the turbo-blower condensers by three steam-turbine driven circulating water pumps. Motor-driven pumps supply the turbo-generator condensers. All water is discharged to a circulating water tunnel directly connected to the river. Two steam-turbine driven service water pumps with a combined capacity of 70,000,000 gal per day pump from this tunnel into the service

water system to supply minimum cooling requirements to the coke plant, blast furnaces and open hearths in case of electrical failure at the pumping station. One pump is normally kept "floating" on the service pressure system, relieving the load on the pumps at the river station.

The remaining half of the water from the sedimentation basins flows back to the pumping station through the main flume lower levels to the service water pump intake wells. Four of the bays are each equipped with 30-in., two-stage, vertical turbine pumps delivering 20,000 gpm against a total dynamic head of 160 ft, each driven by a 1000-hp, 585-rpm, 2300-volt, squirrel cage motor. The fifth bay is equipped with two similar third-sized pumps delivering 6500 gpm, powered by 350-hp, 720-rpm motors. An automatic control system incorporating a series of high and low pressure switches connected to the service water main starts or stops pumps by one-third pump size increments as needed to maintain a nominal 60 psig pressure at the pumping station.

Water may be supplied to the pumps from three sources, either from the sedimentation basins, directly from the river or from recirculated clarified water from the wastes treatment plant. The pumps discharge 10 ft below their base plates through automatically controlled cone plug valves. The cone valves prevent damage to pumps and piping from water hammer by closing and opening at pre-determined rates when pumps are stopped and started.

Service pump output is measured by insert type venturi tubes located down-stream from the cone valves in each of the pump discharges. Flows are transmitted to the central controls building where they are indicated, recorded and totalized. Cooling water flow to the power station is measured by another venturi tube in the discharge pipe adjacent to the sedimentation basins. A secondary indicating dial in the cooling water chlorinator building assists the operator in regulating chlorine dosage.

Chlorine is added automatically in controlled doses on an intermittent program to the service and cooling water systems to control the growth of slime in pipe lines and equipment. A valving arrangement permits chlorine solution to be added to the sedimentation basins to control algae growth. Two 6-kw evaporators at the pumping station and one adjacent to the cooling water outflow supply chlorine for the diffusers. Experience has proved that continuous chlorination is not necessary, consequently a program controller, timing a proportional rate controller, is used to intermittently dose outflows according to the quantity of flow.

CLEAR WATER SYSTEM

Processes in the sheet and tin mill area require water of better quality than general service water. For these processes, a separate clear water system serves the area. The system receives its water supply from two horizontal collector type wells located approximately 50 ft from the river banks. Water percolated upward through the natural sand and gravel beds in the area is of high quality with a minimum of suspended solids. The two clear water collectors, "A" and "B," are located 3000 ft apart and consist of 13-ft diameter concrete caissons sunk to about 50 ft below ground level. Each well is equipped with 10-in. diameter horizontal slotted collector pipes, extending radially toward the river, totalling over 1000 lineal ft. Two vertical turbine pumps rated at 3600 gpm at 65 psig distribute the water from each well. A surge tank and automatic controls are supplied at each well to maintain the proper pressure. Metering is done by an orifice plate installed in the 36-in. main entering the sheet and tin mill area. Total clear water required is about 16,000,000 gal per day.

POTABLE WATER SYSTEM

A third well, "C," is located one-quarter mile south of well "B" to supply water for employee welfare throughout the works. The design is essentially the same as the clear water wells but with three 1200-gpm vertical turbine pumps discharging into an 18-in. cast iron distribution main at 65 psig. Total requirements of approximately 5,000,000 gal per day are metered by an orifice plate installed in the line a short distance from the well. Chlorinator equipment is installed at the well to insure that the water will meet stringent company and municipal specifications. Interconnections between wells "B" and "C" permit clear water to be pumped to well "C" for chlorination and distribution as potable water when necessary.

BOILER MAKE-UP WATER

A separate treatment plant supplied from the service water system and consisting of a flash mixing tank for the addition of lime, ferric sulphate and chlorine, two rapid flow coagulators and clarifiers, four filter units using finely divided anthrafilt as the filter medium and four gravity resinous-zeolite softeners prepares water for use in the steam generating units. The feed water is further improved by the addition of sodium sulphite and solium phosphate to remove absorbed oxygen and decrease hardness.

SHEET AND TIN WASTE TREATMENT PLANT

The flow of wastes through this plant is shown on the flow diagram, Figure 2. A pictorial view of the treatment plant is shown by Figure 7. Insoluble oils from the five-stand mill including palm oil, lubricating oils and greases which will coalesce into an oil sheet in quiet water, are intermittently pumped to a 42,300-gal storage tank. The mixture of oil and water is permitted to stand in the storage tank until gravity separation of oil and water takes place. When close to 20,000 gal of oil has accumulated, as determined by visual sampling lines at various levels on the tank, the oil is transferred to a palm oil storage tank. Waste palm oil is trucked away for reclamation. Oily water remaining in the storage tank flows to the oil separator.

The oil separator is a standard duplex tank, divided into two chambers with oil skimmer and sludge collector flights in each chamber. Each half has a capacity of 55,000 gal, allowing a retention time of 40 minutes for a design flow of 3000 gpm. Oil carrying water enters the primary chamber over film rupture trays which aid in merging the oil globules, then slowly passes through the primary and secondary chambers. Oil is skimmed off through manually positioned skimmer tubes and pumped to the 23,800-gal capacity skimmed oil storage tank. Oil is decanted to tank trucks for disposal and the separated water recirculated through the system.

Figure 7 — The sheet and tin waste treatment plant must handle oils, acids and alkalis. Efficiency is obtained by having some of the waste neutralize others.

Sludge, scraped to troughs in the two chambers by the collector flights, is pumped to the clarifier sludge sump and pumped with clarifier sludge to a sludge lagoon. All the water processed in this treatment plant eventually flows through the separator. The height of water passing over the separator effluent weir is continuously recorded for determination of flow through the plant. The clarified effluent flows to the terminal waste treatment plant.

Intermittent flows of soluble oils from the roll shop, motor room precipitator installations, five-stand and four-stand rolling mills are stored in a 42,300-gal storage tank. The contents of this tank are bled into the continuous flow from the four-stand mill oil skimmer tank. Intermittent flows of all the wastes are stored and then released gradually into continuous flows to prevent upsetting plant operation. The combined flow is mixed with acid rinse water, spent pickling solution and fresh sulphuric acid in a 35,500-gal flash mixer. During a design retention time of 28 minutes, the pH of the mixture is lowered to 5 by the acid additions, breaking the oil emulsion into globules large enough to float. The small flow of hydrochloric acid from the hot dip tinning lines also aids in this process. Fresh acid is added only when the acid content of acid rinse water, normally about 0.064 per cent, is not sufficient to break the oil emulsions. Spent pickling solution composed of approximately 6 per cent sulphuric acid and 15 per cent ferrous sulphate is added to take advantage of the excellent flocculating characteristics of ferrous sulphate. A 3500-gpm paddle type mixer aids the mixing process and starts flocculation.

Flash mixer effluent flows to a 60-ft diameter combination flocculator-clarifier with a 214,000-gal capacity. The entrance well where flocculation starts is 20 ft in diameter and is surrounded by a 32-ft diameter flocculating chamber. Flocculation is aided by gently stirring the mixture with two 1000-gpm agitators. Pretreated chromic wastes from a chromium waste pretreatment plant, sodium orthosilicate from the cleaning lines, soda ash solution used in hot dip tinning, and lime slurry produced in a 30-ton per day slaker are added in the clarifier entrance well. The wastes combine, aided by ferrous sulphate in the spent pickling solution, forming three insoluble compounds — calcium sulphate, ferrous hydroxide and silicic acid. These compounds are agglomerated in the flocculating chamber. Leaving the flocculating chamber, the water enters the clarifying chamber where the "floc" settles carrying with it other finely divided particles and some absorbed oil. Lighter oils rise to the surface and are skimmed off to a scum trap. Accumulated sludge is scraped to a central sump by the circular collector and pumped to the sludge lagoon. Clarifier effluent flows to the oil separator for further oil removal.

From the foregoing it can be seen that soluble oil recovery is a two-stage process. First the oil emulsion is broken by acid addition lowering the pH to a value of 5 and then the addition of lime and alkaline wastes raises the alkalinity to a pH between 9 and 10. The resulting high pH could be lowered by further processing, but it is beneficial in raising the pH of the slightly acid wastes at the terminal wastes treatment plant to which the oil separator effluent flows.

Spent pickling solution is collected in two 200,000-gal. storage tanks. Although the majority of the solution is trucked away for processing by an independent concern, an acid neutralization plant capable of neutralizing the entire output of the plant has been installed.

Four wooden reaction tanks, 10 ft in diameter, with a capacity of 4700 gal each, connected in series for gravity flow are used to neutralize the solution. Approximately one pound of lime is added in slurry form for each gallon of solution treated. The lime, acid and ferrous sulphate react to form two stable compounds — calcium sulphate and ferrous hydroxide. The resulting sludge and water is all pumped to the sludge lagoon where solids settle out and the water percolates into the soil or evaporates.

Chromium wastes are prepared for treatment in the flocculator-clarifier by chromium wastes pretreatment facilities. Continuous rinse flow from the electrolytic tinning line contains 40 ppm of sodium dichromate and 150 ppm of sodium acid phosphate. The dip tank at the electrolytic line releases a 2500-gal batch of solution each six weeks containing 5000 ppm sodium dichromate and 25,000 ppm of sodium acid phosphate. These wastes are mixed with spent pickling solution in two 1500-gal reaction tanks equipped with a 1500 gpm paddle type mixer each. Acid solution is drawn from a storage tank adjacent to the reaction tanks containing sufficient acid to operate for 24 hours at the maximum rate.

In the reaction tanks, the wastes combine to form chromic sulphate, ferric sulphate, ferric phosphate and sodium acid sulphate. In the clarifier-flocculator, these compounds react with added lime slurry to form chromium and iron hydroxides and calcium and sodium sulphates. The first three compounds are highly insoluble and are deposited as sludge in the clarifier. Sodium

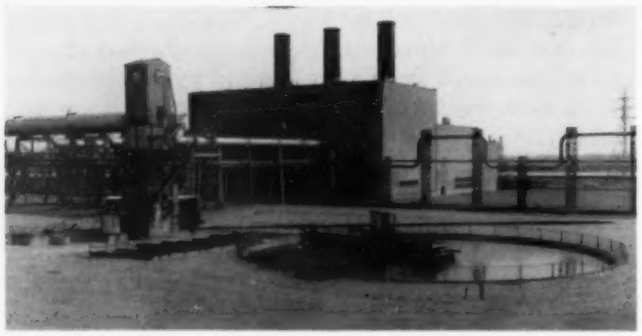


Figure 8 — View shows secondary clarifier used in flue dust removals.

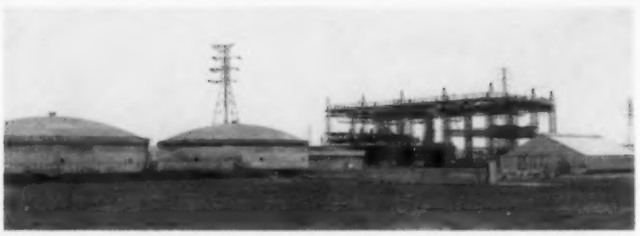


Figure 9 — Secondary sewage treatment plant consists of pumping stations, comminutors, clarifier-digester, trickling filter, secondary clarifier, chlorinating equipment and sludge drying beds.

sulphate is highly soluble but harmless and remains in the effluent in very dilute solution.

TERMINAL WASTE TREATMENT PLANT

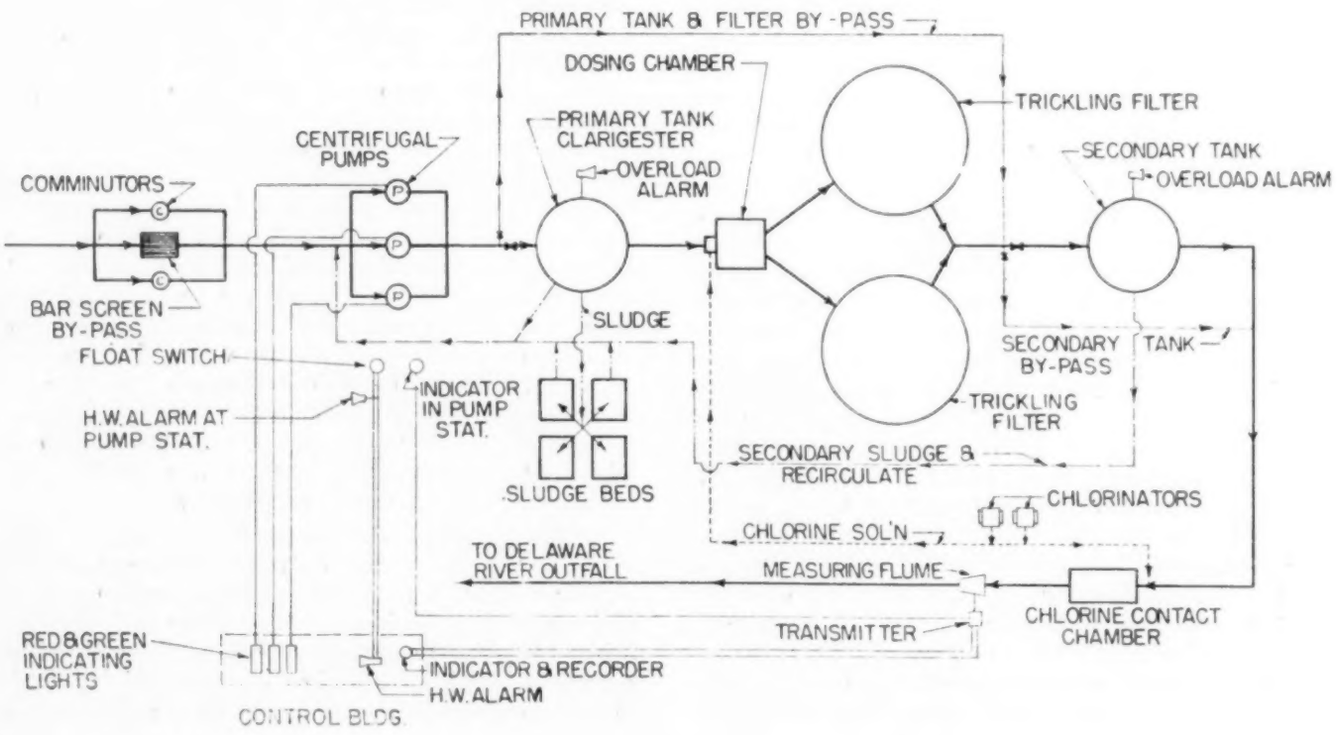
The terminal waste treatment plant receives water from the sheet and tin mill waste treatment plant, rolling mill scale pits and miscellaneous outflows from the open hearths. Here, any remaining dissolved and suspended solids and floating oils and greases are removed by skimming and gravity settling with aeration aiding both these processes. The flow through this plant is indicated in Figure 2.

Three 20,000-gpm, 100-hp, vertical propeller type pumps lift the wastes from the low intake level to elevation +23.0 for gravity flow through the treatment processes. The pumps are automatically controlled by a float operated controller which places the required number of pumps in service according to the wet well water level. The discharge passes through a 6-ft measuring flume to the pre-sedimentation basins. The measured flow is recorded at the central controls building and is used to determine the number of basins to be placed in service.

Aeration is accomplished in four parallel chambers, each 30 ft long by 18 ft wide and 13 ft 6 in. deep. The aeration equipment consists of three positive displacement blowers delivering air at 8 psig pressure to 48 jet impingement type aerators in each chamber. Five minutes retention is provided to allow the bubble cloud formed to bring finely divided particles and oil globules to the surface. Stirring action supplied by the bubbles also causes flocculation of other particles into settleable clumps of larger size. The aerated wastes then pass over a weir through influent channels to the four pre-sedimentation basins. These basins are 130 ft long, 18 ft wide and 15 ft deep allowing for a 16-min retention period. Drag flights and oil skimmers remove sludge and scum. Sludge scraped to the sludge trough is automatically pumped to a sludge lagoon in the area by timer controlled pumps automatically started when collectors are in operation.

Oil gathered by the collector flights is removed through manually operated slotted skimmer pipes to a two-compartment scum trap. Scum passes from the first compartment into the second over an adjustable weir. When a sufficient amount is collected, it is pumped to the scum thickeners. Excess water is decanted from the first compartment to the basin effluent flume.

Figure 10 — Flow diagram of secondary sewage treatment plant.



Two oil and scum thickener tanks, each 15 ft in diameter by 10 ft deep, are operated alternately to provide a maximum retention time. In the tanks flocculator paddles break up the scum, removing air and causing light oils to rise to the surface and heavy particles to deposit as sludge. Both are pumped to a 42,000-gal capacity storage tank. After storage, excess water is decanted back into the influent flume for recirculation and the oil is trucked away for disposal. Clear effluent from the thickeners is collected in a scum manhole, again skimmed and finally passed on to the influent flume for recirculation.

After clarification in the pre-sedimentation basins, the water flows over V-notch weirs to the effluent flume and passes to the secondary sedimentation basins. These basins are identical to the river water basins in construction but are equipped with log boom oil skimmers and additional pumps and equipment for removing skimmed oils. Further clarification is obtained in a 10,000,000-gal storage lagoon. Water is stored here until recirculated in the service water system or, if not needed, released to the river.

BLAST FURNACE WASTE TREATMENT PLANT

Flue dust laden waters from the gas washers and precipitators pass through a conventional primary thickener and then to a secondary clarification plant in the blast furnace area. The secondary clarifier and related equipment are shown in Figure 8. Effluent from the primary thickener is mixed with lime slurry in a flash mixer and flows to a 74 ft × 28 ft × 16 ft water depth flocculator chamber as shown by the flow diagram. Approximately 10,000 gpm of wash water is treated by the addition of about 0.4 lb of high calcium lime for each thousand gallons, producing a clarifier effluent containing about 12 ppm suspended solids. With two furnaces operating, approximately 20 tons per day of flue dust is removed. Sludge from the 1,200,000-gal secondary clarifier is pumped, along with primary thickener sludge to a separate flue dust storage lagoon. Clarifier effluent flows directly to the river through a measuring flume. Indications from the flume control the automatic addition of lime to the flash mixer.

SANITARY SEWAGE TREATMENT PLANT

Sanitary sewage collected in a separate sewage system is pumped to the treatment plant by four sewage booster pumping stations. The treatment plant is composed of a pumping station, comminutors, a combination clarifier-digester, trickling filters, a secondary clarifier, chlorinating equipment and sludge drying beds. Figure 9 presents a general view of these facilities. It is capable of handling a twenty-minute peak load, the equivalent of 2,500,000 gal per day.

Flow through this plant is indicated by Figure 10. Solids are shredded by two comminutors and then pumped by automatically float controlled centrifugal pumps to the upper chamber of a two-story clarifier-digester. Clarifier sludge is scraped by a revolving collector into the bottom digestion chamber. Surface scum is removed to the pumping station wet well for recirculation. Digested sludge flows by gravity to four greenhouse sludge drying beds. The clarifier effluent flows to two trickling filter dosing tanks. These trapless syphon dosing tanks supply intermittent flows to the trickling filter reaction distributors to prevent stationary dribbling during periods when flow is not sufficient to cause the reaction arms to revolve. The sewage is trickled through a 7-ft deep stone layer in the completely enclosed filter tanks, reacting biologically with built-up filter bacteria to form stable organic oxides. The flow is collected in underdrains and is passed to a secondary settling tank. Trickling filter humas settles as sludge and is recirculated to the digestion chamber. Surface scum is removed to the pumping station wet well for recirculation. A telescopic valve permits underflow draw-off from the secondary tank to provide recirculation for keeping the trickling filters wet during low flow periods.

Clarified water from the secondary tank flows to a chlorine contact chamber of the over-and-under baffle type, providing a contact time of sufficient duration to give a residual chlorine content of 0.5 ppm in the effluent. Plant outflow is measured by a measuring flume transmitting flows to an indicating recorder in the control building.

STORM SEWERS AND DRAINAGE

Storm sewers collect surface water which has not been in contact with industrial processes and conduct it to three open drainage canals running the length of the plant, discharging to the river.

CENTRAL CONTROLS BUILDING

In the central controls building are concentrated the major controls and instruments for the operation of the river pumping station, industrial wastes and sanitary sewage treatment plants. It also contains a small laboratory for water and waste analysis, an instrument repair shop and blowers for the aeration equipment.

Electrical service is supplied from a 69-kv transmission line through transformers and switchgear which reduce the voltage to 2400 volts for use by the large size pumps. The voltage is further transformed to 480 volts and 208/120 volts for use by smaller motors and miscellaneous power, lighting and control equipment. The outdoor substation and central controls building may be seen in the background of Figure 9.

SUMMARY

The design of the water processing facilities of Fairless works encompassed three basic aims: dependability, a high degree of automatic operation, and high quality of water released to the river. Automatic controls have made possible the use of very little manpower considering the quantities of water and waste processed. Careful design followed by regular planned maintenance has resulted in excellent dependability. Flow arrangements permitting bypassing of facilities without detriment to either plant operation or quality of outflows have permitted uninterrupted operation of the works. Operating experience has proven that these factors have resulted in outflows of a quality that is better than existing river waters.

The President's Message

A year of decision, of contemplation and of hope faces us as we enter a new year fraught with much anxiety on one hand and extreme optimism on the other.

We, as engineers and members of one of the greatest economic segments in the world, must make decisions, individually and collectively, which can and will affect our American way of life. Every decision, be it concerning quality, costs or some matter affecting the community in which we live, should be predicated upon the principle of the preservation of free enterprise and individual freedom.

This, being the threshold of a new year, is the proper time to pause and contemplate how we, through organizations such as the Association of Iron and Steel Engineers, can best serve our community, our nation and our God, both technologically and socially.

It is my fervent hope that, as President of the Association and with the aid of the officers and staff, we will be able to strengthen the lines of communication through which we may receive and distribute problems which confront us in the steel industry.

These lines of communication will only be as strong as the membership, and it is my hope that all members will take advantage of the fellowship it offers to the betterment of all.

JOHN H. VOHR
President, AISE

John H. Vohr

PRESIDENT, 1955

ASSOCIATION OF IRON AND STEEL ENGINEERS

JOHN H. VOHR, general superintendent, United States Steel Corp., Gary Steel Works, Gary, Ind., graduated from Cornell in 1916 in mechanical and electrical engineering. Upon graduation he worked with the New York State Railways as an electrical engineer. He then served in World War I, enlisting in the aviation section of the Signal Corps and leaving it as a pilot (1st Lt.) in 1919. Upon his return he joined the American Sheet and Tinplate Co. at Farrell, Pa., working up to master mechanic.

In 1919, he was transferred to Gary as night superintendent of the 42-in. strip mill. He left American Sheet and Tinplate in 1931 and worked on the installation and operation of the new strip mills of the Inland Steel Co., and Youngstown Sheet and Tube Co.

In 1936 Mr. Vohr went with Granite City Steel Co., Granite City, Ill., as superintendent of the hot and cold strip mills and in 1937 was made general superintendent. In 1942 he joined the Carnegie-Illinois Steel Corp., working in the general offices in Pittsburgh until his appointment in 1943 as assistant general superintendent of South works at Chicago, Ill. In 1949 he was promoted to general superintendent of the Gary Steel Works.

W. H. COLLISON
First Vice President

JAMES D. O'ROARK
Second Vice President

LEONARD LARSON
Treasurer

NEWLY ELECTED OFFICERS AND DIRECTORS

W. H. COLLISON was graduated from the University of Cincinnati in 1926 with a degree of chemical engineer. While at the university, he took a cooperative course and worked in the coke plant of Pittsburgh Crucible Steel Co., beginning in 1924, and continuing after graduation until 1927. He then went to the Central Alloy Steel Corp., Massillon, Ohio, as heater in the coke plant, and was made turn foreman shortly thereafter. In 1935, Mr. Collison went with the Pure Oil Co., Marcus Hook, Pa., as a chemist. Following this he came to Detroit as boss heater for the new coke plant of Great Lakes Steel Corp., being subsequently promoted to assistant superintendent and later to superintendent, blast furnace division and in 1954 he was promoted to plant superintendent, blast furnaces and coke works.

JAMES D. O'ROARK was born in Broadway, Va. He was graduated from Ohio State University in 1926 with a degree in electrical engineering. After graduation he was employed in the student engineer training course and test floor from 1926-1930 at Westinghouse Electric Corp.'s East Pittsburgh works. He has been employed by Weirton Steel Co. from 1931 to the present date as electrical field engineer, electrical foreman of strip steel and sheet mill dept., assistant electrical superintendent, electrical superintendent, and assistant manager of service and maintenance, the position he now holds.

LEONARD LARSON was employed as a draftsman at Jones & Laughlin Steel Corp., and Carnegie Steel Co., in Pittsburgh, Pa., from 1913 to 1917, while attending night school at Carnegie Institute of Technology. In 1917 he moved to Massillon, Ohio as a draftsman for Central Steel Co. He was appointed chief draftsman in 1918, and assistant chief engineer for Central Alloy Steel Corp., in 1926 in a merger between Central Steel Co., and United Alloy Steel Corp. In 1929 he was appointed chief engineer, and served in this capacity for Central Alloy Steel Corp., and Republic Steel Corp., after a merger in 1930, until 1939 when he was transferred to the Cleveland district as district chief engineer, the position he now holds. From 1933 to 1936 he spent about one year on special open hearth work for the corporation, and about two years in the operating department as divisional superintendent at the Massillon Steel plant.

EMIL KERN was graduated from the University of Stuttgart, Germany, in 1926, and began his career as a machinist and designer with Mesta Machine Co., in 1930. He became associated with Reynolds Metals Co., as chief mechanical engineer in 1945, and joined the Allegheny Ludlum Steel Corp., Pittsburgh, Pa., as chief engineer the following year. In May 1949, he was elected a vice president in charge of engineering of the Allegheny Ludlum Steel Corp.

S. C. READ attended Purdue University and the University of Michigan. He graduated from the University of Michigan with a degree in mechanical engineering, and later received a master's degree in metallurgical engineering at Carnegie Institute of Technology. Mr. Read started to work for Jones & Laughlin Steel Corp., Pittsburgh, Pa., in 1924 as assistant superintendent power department at the South Side works. In 1938, he was made master mechanic of rolling mills, Pittsburgh works. He was appointed superintendent of blooming department and rolling mills, Pittsburgh works in March 1946, and named manager of maintenance for the entire corporation in November 1947. Mr. Read has since been made director, construction and maintenance for Jones & Laughlin Steel Corp.

A. M. CAMERON was born in Pictou County, Nova Scotia, and was educated at Carnegie Institute of Technology. He served his apprenticeship as a roll turner at the Nova Scotia Steel & Coal Co., and then moved to Crucible Steel Co. of America, Pittsburgh, Pa. He later worked as roll shop foreman at the Philadelphia Roll & Machine Co., and as roll designer at Atlas Steels, Ltd., Welland, Ontario. Mr. Cameron has since held positions of production planning, assistant superintendent of rolling and forging. In April, 1951, he was appointed superintendent of rolling mills and S. P. forge.

EMIL KERN
Secretary

S. C. READ
Director-at-Large

A. M. CAMERON
Director

CLYDE S. CASSELS
Director

KENNETH R. DANIEL
Director

E. F. DONATIC
Director

ASSOCIATION OF IRON AND STEEL ENGINEERS 1955

CLYDE S. CASSELS was born in Philadelphia, Pa. in 1905. He received a degree of B.S. in Civil Engineering from Drexel Institute of Technology. From 1928-1935, he did miscellaneous construction work and has since held various positions in the engineering department of Henry Disston & Sons, Inc. Mr. Cassels has been chief project engineer with responsibility for plant and equipment acquisition, construction and maintenance since 1945.

KENNETH R. DANIEL was born October 13, 1913 in Shrewsbury, Mass. He graduated from the University of Alabama in 1936 with the degree of B.S. in Mechanical Engineering. After graduation he was employed by American Cast Iron Pipe Co., and served in melting, research, fittings foundry, and the engineering departments. He went on active duty, U. S. Army, in 1941, and was discharged with the rank of lieutenant-colonel at the end of the war. In 1948 he was appointed chief engineer, American Cast Iron Pipe Co.

E. F. DONATIC was born in Chicago. While studying electrical engineering at the Illinois Institute of Technology, he worked as an electrical apprentice at Interstate Iron and Steel Co. In 1934, he became general foreman of the electrical department when the company went under the management of Republic Steel Corp. In 1943 Mr. Donatic was promoted to electrical superintendent. In 1946 he joined Kaiser Steel Corp., as assistant superintendent of maintenance. Later he was made superintendent of maintenance, and in 1950 became division superintendent of services. He was promoted to his present position of assistant general superintendent, services, in 1953.

T. M. FAIRCHILD was born in Portville, N. Y. in 1912. He was graduated from the Pennsylvania State College, School of Mineral Industries with a B.S. degree in Ceramics. He began his career as a ceramic engineer with the Bethlehem Steel Co.'s Johnstown plant. Since then he has served as general foreman, brickmasons; assistant superintendent, yard department; and superintendent of the Franklin Mills. He is now assistant to general manager at Bethlehem Steel Co.'s Johnstown plant.

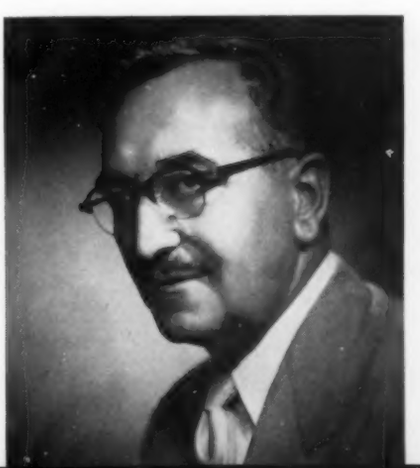
JOHN A. FERGUSON was born in Roker, England, in 1905. He attended Ohio State University, graduating in 1928 with a degree in electrical engineering. He worked for Pennsylvania & Ohio Power & Light Co. (now Ohio Edison Co.) from 1928 to 1932 as distribution engineer, then for the city of Youngstown, Ohio from 1938 to 1940, as contract engineer on street widening program. From 1940-1942 he was electrical engineer for the Standard Oil Co. of Ohio. He joined Goodyear Tire & Rubber Co., Akron, Ohio in 1942, supervising and inspecting electrical installations in connection with construction of a military aircraft plant. He went with Republic Steel Corp., Youngstown, Ohio district in 1942 as electrical engineer, the position he now holds.

GEORGE J. GOCKSTETTER was born in Canton, Ohio. He graduated from R.C.A. Institute in New York City, and later attended Northwestern University night school during 1944-1947. He joined Republic Steel Corp., in 1932 and was employed as wireman, substation inspector and telephone repairman. Transferred to the combustion department in 1937, he held various positions until 1943 when he was transferred to the Chicago plant as assistant chief combustion engineer. In 1947, Mr. Gockstetter was promoted to the position he now holds, chief combustion engineer of the Chicago district.

T. M. FAIRCHILD
Director

JOHN A. FERGUSON
Director

GEORGE J. GOCKSTETTER
Director



EVERETT C. HITE
Director

CARL G. HOGBERG
Director

HARRY L. JENTER
Director

EVERETT C. HITE was born in Pleasantville, Ohio in 1913. He graduated from Ohio State University in 1935 with a degree in Ceramic Engineering. This same year he joined the Timken Roller Bearing Co., Steel and Tube Division, Canton, Ohio in their research department. He has successively held the positions of refractories engineer, combustion engineer, maintenance engineer, and since 1949 has been assistant superintendent of maintenance.

CARL G. HOGBERG was graduated from the Michigan College of Mining & Technology in 1935. In the same year, he began work as a blast furnace apprentice at United States Steel's South Chicago works. In 1941 he was transferred to Pittsburgh, and since that time has been associated with blast furnace activities on U. S. Steel's operating committees. His present position is assistant chairman, operating committees, United States Steel Corp. He is the author of a number of papers on blast furnaces. He is also active on a number of industry-wide technical committees and in many steel industry organizations.

HARRY L. JENTER was born in Trenton, N. J. He joined the American Steel & Wire Division's Trenton works in 1917 as a draftsman, and for the next few years alternately worked for the division and attended college. In 1926 he was graduated from Syracuse University with a degree in mechanical engineering and transferred to the Cleveland office. In 1928 he was made assistant foreman at the Newburgh Wire works. Mr. Jenter was transferred to the Cuyahoga works cold roll strip department in 1932, and in 1934 was made general foreman. He became assistant superintendent of the works in 1935, general superintendent in 1939, and in 1942 transferred to the headquarters office as assistant to the vice president of operations. He resumed the post of general superintendent of Cuyahoga works a year later, was made chief engineer in 1950, assistant district manager in 1952, and manager of operations Cleveland District, American Steel & Wire Division, U. S. Steel Corp., in 1953, the position he now holds.

PAUL LINDBERG, JR. started in the ceramic department of Timken Steel & Tube Co., in Canton, Ohio in 1931. He transferred to the mill metallurgical department in 1933, and remained in this department until 1938. Mr. Lindberg then joined Copperweld Steel Co., in Warren, Ohio as mill metallurgist and became melting superintendent in 1944. In 1948 he joined McLouth Steel Corp., Detroit, Mich., and is now superintendent of the hot metal division.

CLAYTON L. SQUIER was born in Madison, N. J. He graduated from Lehigh University with a B.S. in Electrical engineering in 1935, and in that year started with Bethlehem Steel Co., Lackawanna, N. Y. as engineer in the electrical power department. He became electrical foreman, 12-in. bar mill, in 1940, and in 1946 Mr. Squier became assistant to electrical superintendent, Lackawanna plant, the position he now holds.

LEONARD A. TERRY began work in the electrical department of National Tube Co., Lorain, Ohio in 1917. He enlisted in the Navy in 1918. After graduation from Bliss Electrical School in Washington, D. C. in 1920, he returned to the Lorain works as supervisor of electrical testing, and subsequently became general foreman of maintenance. He served as chairman of the AISE Cleveland district section in 1932. Mr. Terry was transferred to the Gary works as superintendent of power and electric department in 1942. He is a life member of the AISE.

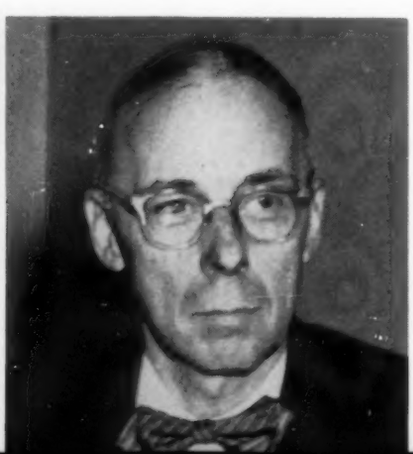
DONALD E. WHITEHEAD attended the Carnegie Institute of Technology. He worked in lubricant sales for the Sun Oil Co., Gulf Oil Corp., and Tide Water Associated Oil Co., Inc. He then went to work at the Homestead works of Carnegie-Illinois Steel Corp. as lubrication engineer and was then advanced to general lubrication engineer of the entire Carnegie-Illinois Steel Corp. He is now general lubrication engineer, Crucible Steel Co. of America, Pittsburgh, Pa.

PAUL E. LINDBERG, JR.
Director

CLAYTON L. SQUIER
Director

LEONARD A. TERRY
Director

DONALD E. WHITEHEAD
Director



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ASSOCIATION OF IRON AND STEEL ENGINEERS

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1948 A. J. FISHER, *General Manager*, Bethlehem Steel Co., Johnstown, Pa.
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1950 A. S. GLOSSBRENNER, *Vice President Charge Operations*, Youngstown Sheet and Tube Co., Youngstown, Ohio.
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1952 I. N. TULL, *Electrical Superintendent*, Republic Steel Corp., Cleveland, Ohio.
1953 JOHN L. YOUNG, *Vice President, Engineering*, United States Steel Corp., Pittsburgh, Pa.
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EMIL KERN, *Vice President in Charge of Engineering*, Allegheny Ludlum Steel Corp., Brackenridge, Pa.

By GILBERT D. DILL, Engineer In Charge Steel Div., American Wheelabrator and Equipment Corp., Mishawaka, Ind.

TEN YEARS of MECHANICAL DESCALING of Hot Rolled Steel Products

. . . . shot blasting units are finding many promising applications in the steel industry . . . .

▲ ABOUT 1937 the process of mechanical blast cleaning of hot rolled steel using high speed bladed wheels instead of air pressure was introduced to the steel industry as a means of reducing or eliminating acid pickling. The wheels as then designed were made of mild steel and the blades of alloy iron. The blasting abrasive used was hard (rockwell 65C) chilled iron and very friable. The balance of the equipment consisted of the blast cabinet, abrasive handling equipment, material conveyors and a dust collector to provide ventilation of the equipment.

The first major application in the initial stages of the development of this process was a complete continuous descaling line to prepare carbon steel strip for cold rolling without the use of acid pickling.

At this time the only available abrasive was the above mentioned cast iron shot or grit and its use in this production line brought out the following serious objections which were eliminated by recent developments:

1. The chilled iron abrasive shattered on impact and left small pieces imbedded in the steel surface.
2. Wear rate of equipment was very high due to the destructive action of chilled iron abrasive. This caused a high maintenance cost.
3. Loss of production through down time and contamination.

Our company believed these difficulties could be overcome and to factually determine the future possibilities of the process, a complete investigation and report was made by J. D. Keller, consulting engineer, in April, 1943. This report indicated that if these three problems could be solved, we would have a process acceptable by the steel industry.

In 1944 it was decided to establish an intensive research and investigation program to prove conclusively that through development of more efficient equipment and a better abrasive, the process could be applied to the various descaling problems confronting the industry. As a result, today, after ten years, we have a total of sixty-two installations throughout the industry performing nearly all of the standard jobs of descaling and numerous special applications.

A 16-wheel unit now being built for the Empire Steel Co. will be the largest strip cleaner built to date. The wheels and parts of this new machine, which before had an operational life of not more than 160 hours, now are capable of continuous operation for more than 2000 hours with only periodic inspection. This tremendous increase was made possible by the use of alloy parts, hardened steel parts, and most important of all, a new alloy steel shot abrasive having a longer life, a non-friable structure and guaranteed quality. All of these have eliminated the previously mentioned objections created by chilled iron abrasive. This material, now in use in nearly all of our installations, has reduced abrasive consumption from fifty pounds per wheel hour of operation for the old chilled iron abrasive to eight to ten pounds per hour. Its toughness makes it possible to use alloy wear plates without fear of increasing abrasive consumption.

These new alloy wear parts last thirty to forty times longer than carbon steel parts and together with other improvements have brought to life the dream of 20-turn operation of blast cleaning equipment.

There are many applications for the process throughout industry to clean castings, forgings, weldments and even whole combat tank hulls and turrets. In this paper, however, only the following uses directly connected with the steel industry will be described.

SLAB AND BILLET DESCALING FOR INSPECTION

Scarfing of carbon steel and grinding of alloy steel has been the accepted method of removing surface defects at this stage of steel manufacture. Today, however, several companies after thorough testing are operating wheel blasting equipment to remove scale and disclose defects. This method is capable of high production and large savings in material and labor.

Our largest slab and billet cleaning unit so far installed is a 4-wheel machine throwing 1000 pounds per wheel or a total of 4000 pounds of abrasive per minute which descales material up to 15 × 15-in. square billets, 8 to

10 ft long. Other installed units are handling smaller shapes with less wheels.

It is difficult to assess the value of this process within the scope of this paper and the author believes that a list of its operational results will allow comparison between this new method and present operations. These operating data are the following:

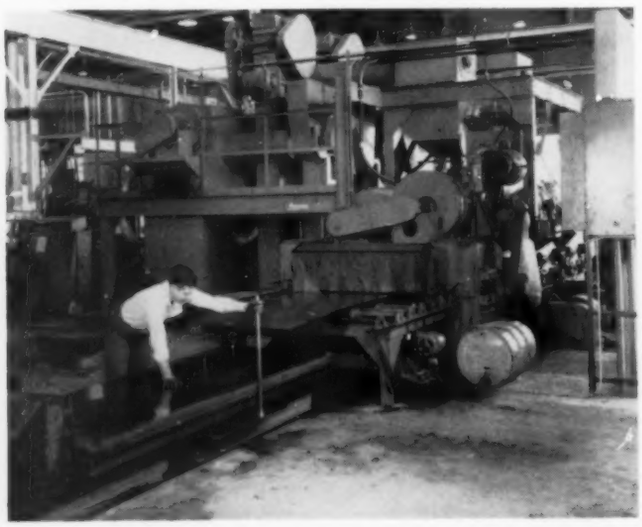
1. The above mentioned 4-wheel machine costs $16.48 per hour to operate not including direct labor and fixed charges. It will descale, using a hard malleable iron grit abrasive, at an average rate of 10 fpm depending on the size and shape and type of steel.
2. It will eliminate skin grinding and reduce the amount of spot grinding on alloy steel. This has proven to amount to more than 50 per cent of present grinding costs. The saving in steel, grinding wheels and labor is obvious.
3. It will eliminate a large proportion of present scarfing since it will only be necessary to scarf out the visible defects. The saving in steel, gas and labor will be well above 50 per cent of present scarfing costs.
4. It will greatly increase production through elimination of unnecessary grinding or scarfing and through its ability to be used in a continuous manner, if desired.

SHEET DESCALING

We have eighteen large installations cleaning hot rolled sheets and plates for many varied end uses. The blast cleaning process has eliminated pickling in these cases, and satisfactory end products such as automotive hardware, car and truck frames, decorated containers and many others are produced.

This application was one of the first in the field of carbon steel and some installations have been in operation over five years with remarkably low costs. Several 8-wheel machines incorporated in a cleaning line consisting of feeder, cleaner, leveller, scrubber, roller coater, dryer and stacker are consistently cleaning twenty tons of 16 and 18 gage sheets per hour at a total cost of $2.85 per ton including direct labor and all fixed charges. The basic blasting cost is less than $1.00 a ton.

Figure 1 — Mechanical descaler is cleaning carbon steel for deep draw stock for automotive parts.



Another smaller installation cleans ten to twelve tons per hour at an equivalent cost per ton including direct labor and all fixed charges.

One of the most important factors in the success of this application of the blast cleaning process is its effect on subsequent operations caused by the shot blast etch imparted to the surface of the sheet.

This is a uniformily etched surface having millions of tiny cups or depressions which provides excellent lubricating qualities for rolling, forming, and deep drawing. Where coating is required, it has exceptional ability to provide a mechanical bond with a resultant tight coat.

CONTINUOUS STRIP DESCALING

By far the largest tonnage of material which must be continuously descaled before further processing is carbon steel strip. Today's high speed pickle lines turn out at least 20,000,000 tons per year throughout the entire range of widths and gages.

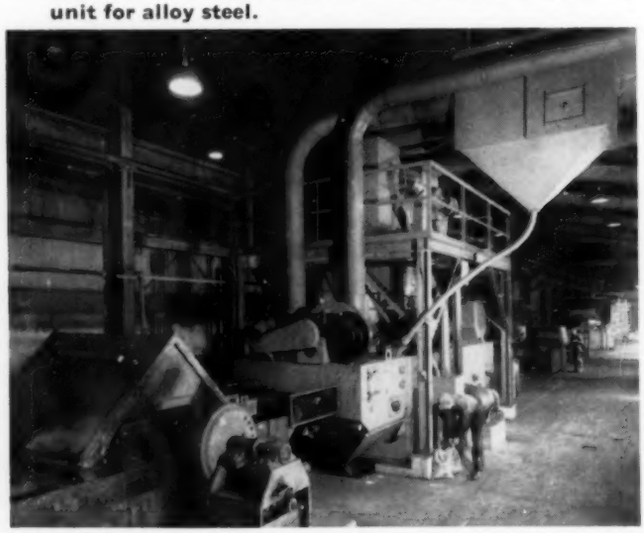
The 16-wheel machine now being built will work with one 60-ft acid tank as a secondary cleaner and is designed to clean an average strip 40 in. wide by 0.074-in. gage at 250 fpm.

A few years ago, the problem of acid pickle liquor disposal was not too important. This is not true today. It is believed that the mechanical cleaning process will replace pickling where acid treatment is not a must. There are eleven of our installations cleaning alloy strip which must be acid passivated, but even here we have cut the acid consumption by 60 per cent or more and the cost per ton by more than 50 per cent through elimination of scale breaking and surface defects.

Of course, to completely analyze this process as compared to pickling, one must know just how much it costs to clean carbon steel strip by wheel blasting. The following analysis made for a large steel company shows the blasting costs for a predetermined tonnage:

1. The 24,320 required tonnage is 152 tons per hour or tons per week of 20 turns.
2. The size of strip is 24 to 48 in. wide by 0.065 to 0.120-in. gage.

Figure 2 — Continuous operation is obtained in this line consisting of annealing, shot blasting and pickling unit for alloy steel.



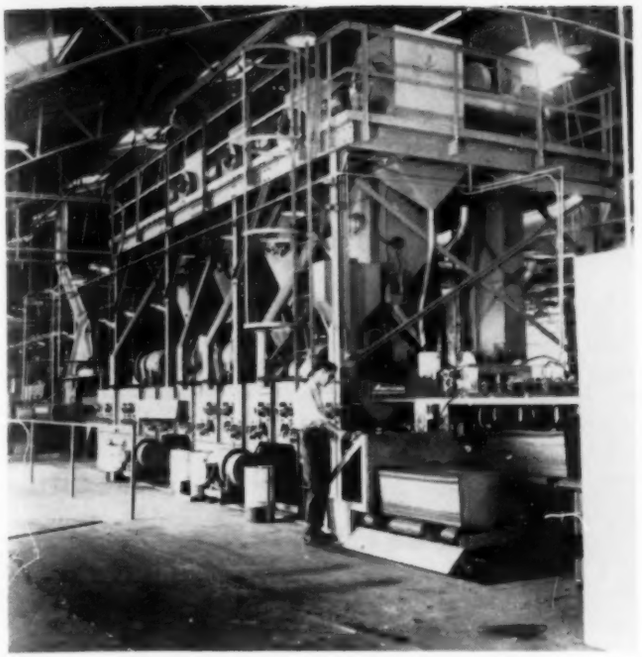


Figure 3 — Shot blast sheet cleaning line shown is used for carbon steel drum stock.

3. The average strip for design is 36 in. wide by 0.083-in. gage which weighs 3.38 pounds per square foot.

   Based on these factors and data secured from tests and operating installations, it will require a 40-wheel machine which is capable of cleaning this average strip at 500 fpm with the use of a minimum of acid pickling.

   If it is desired to reduce acid pickling by only 50 per cent, it would require a 20-wheel machine and 147 ft of acid. Obviously adding more wheels will further reduce the required acid and for those plants now operating continuous pickle lines, a stepwise replacement of acid would seem to be practicable.

   The cost of mechanical descaling is a function of the cost of wheel operation per hour. It includes abrasive consumed, spare parts and maintenance labor and power, and amounts to $2.40 per wheel per hour of operation.

   Thus a 40-wheel machine would cost 40 × $2.40 or $96.00 per hour or 63¢ per ton based on above required tonnage of 152 tons.

   For a 20-wheel machine, this cost would be 50 per cent less or 32¢ per ton. To this, of course, one must add 50 per cent of the acid costs per ton because the wheel blast is only removing part of the scale as compared to 40-wheel operation.

The above costs per ton are for blasting equipment costs only and do not contain operating costs of other equipment in the cleaning line, direct labor and fixed charges. The author is sure that continuous strip can be mechanically cleaned at a lower cost than our present low cost operating sheet cleaners which have an operating cost for blasting equipment of well under a dollar a ton.

Against the above costs, we have not taken a credit for the recovery of all of the scale removed and the abrasive used to remove it. The scale amounts to about 0.8 per cent by weight and when added to the fact that this method of descaling removes practically no virgin metal, the yearly savings of iron as it effects our national economy is in the order of several hundreds of thousands of tons. All of the carbon steel scale recovered can be used for sinter, iron powder and/or magnetic filtration. Alloy scale recovered to date has been thrown away or used in blast furnaces making iron for these special steels.

DESCALING OF BAR STOCK FOR COLD DRAWING

It is an accomplished fact that hot rolled bars up to 6-in. outside diameter and in mill lengths can be mechanically cleaned, pickle-rinsed and lime-coated for about $1.00 per ton cheaper than the cost of straight pickling and liming.

There is equipment which has been in operation for five years that has confirmed this saving. In addition, the cold drawn finish of bars so cleaned is more uniform and has a better appearance.

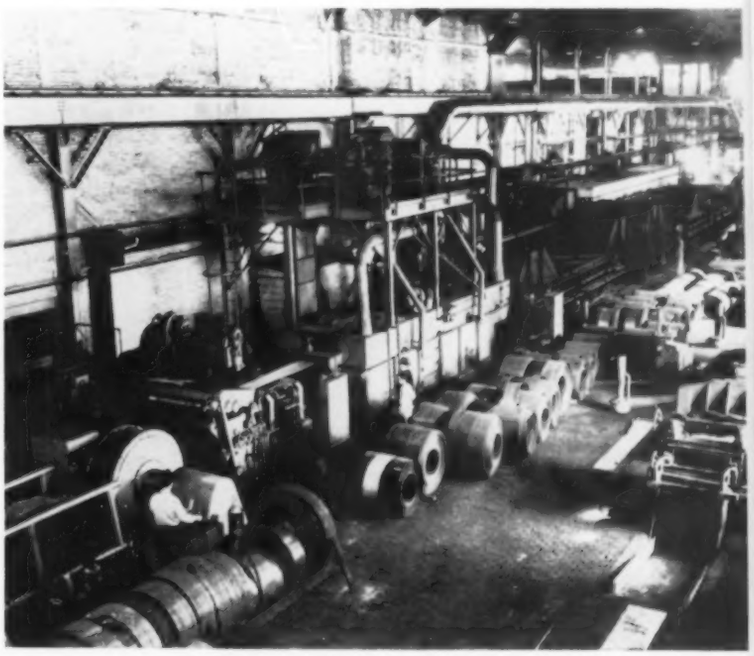
There are many mills today who are batch pickling bars that could realize a reduction in their costs if equipment were installed based on a factual analysis.

WIRE ROD DESCALING FOR COLD DRAWING AND HEADING

Large tonnage tests have proven that wheel blasted rod will cold draw better than pickled rod. Our process required that 3 wheels be focused on the 120 degree increment of the rod's diameter as it is passed through the blast in strand form. The handling of five or more coils to pay-off reels and from recoilers at speeds of 150 fpm and upward has been thoroughly examined and equipment has been developed to operate under these conditions.

The lubrication problem has been overcome on most types of rod due to the ability of the etched surface to pick-up and carry into the drawing die sufficient com-

Figure 4 — Shot blast and pickle line was constructed to process alloy steel.



pound to coat the rod for successive draws or cold header upsets. The extent of this lubrication is indicated by a 15 per cent increase in die life secured on a large tonnage test.

We have been working on these problems for many months with considerable success and a low estimated cost per ton indicates considerable savings as compared to pickling; with particular reference to handling labor.

One of the most interesting features of this application is the possibility of utilizing straight line production. In new plants particularly, and in some old plants, it is now possible to start with the hot rolled coil of rod and continuously clean, coat and draw into wire which may be recoiled as a finished product or passed on into a cold heading machine for such products as bolts, nuts and other special products.

This is particularly attractive to several large companies and by next year we will be able to furnish you with complete data on this very interesting application.

DESCALING OF STRUCTURAL STEEL SHAPES

As far back as the author can remember, all types of structures have been fabricated from hot rolled plates, angles, channels, I-beams, etc. Today the trend is toward mechanically descaling these sections before fabrication to provide a scale free surface which will hold protective coverings better and longer.

It has been pretty well established that structures built of hot rolled material, and only chipped and wire brushed before applying a protective coat, will under service flake off scale and coating because of stress deflections and other weathering effects. This opened surface is immediately attacked by the elements and requires constant maintenance to prevent excessive deterioration.

Information from one large steel company shows that their yearly repair bill for this type of maintenance is in the hundreds of thousands of dollars. They further state that a structure fabricated of scale free steel and properly protected would save in the first year more than enough to offset its higher investment cost.

There are several companies now operating equipment for this purpose and it has been proven that these structures have a greatly increased life with much less maintenance. However, this application is also comparatively new and time must elapse before the author can report specific data on reduction of costs and increased service life. Its reflection on our national economy, however, is indicated if we add the possible increased life to an ore bridge, large mill buildings, highway bridges, oil refineries, chemical plants and many others.

MILL ROLL ETCHING

While this subject does not, strictly speaking, adhere to the title of this paper, the author takes the liberty of mentioning it because it is another new mechanical blasting process established in the steel industry. It is replacing the old air blast method and our eight installations have proven it capable of producing blast etched mill rolls with the following improvements:

1. It etches more rolls in less time, four rolls per hour is common practice.

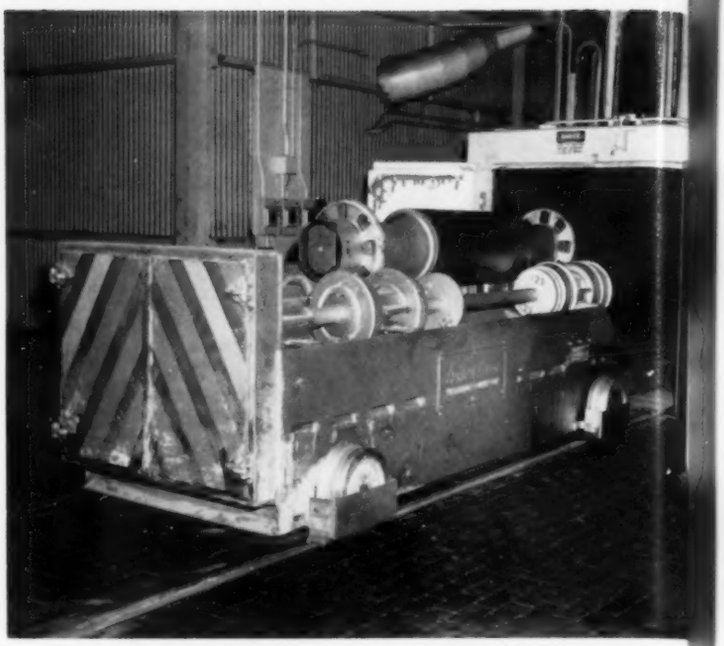


Figure 5 — Shot blasting is used to etch rolls at large eastern steel plant.

2. It provides a more uniform etch as measured by a profilometer — variations as low as 3 microinches across the work face is not uncommon.
3. It increases roll life in the mill as much as 35 per cent.
4. It eliminates the error of human judgment since the process is entirely automatic once it has been calibrated for the desired finishes.
5. It is capable of producing any desired degree of etch through complete adjustable control of the various phases of the process.
6. It eliminates production delays on the mills through its high productive rate.
7. It can be adapted to quick changes from one abrasive size to another with as many as eight different sizes being used.
8. It can readily be designed to identically etch rolls in pairs for increased production and the handling of mill rolls in pairs.

INGOT MOLD CONDITIONING

Another application of interest is a means of improving the surface of ingots by a regular treatment on the interior surface of ingot molds. The various methods of preparing the inside surface of an ingot mold before casting are common knowledge. However, with today's stress on improved surfaces throughout the various stages of steel manufacture, many engineers and operators have stated that improvement should start with the ingot. The first in this field is a large eastern steel mill who has installed an air blast, lance type machine to blast clean the interior surfaces of forging ingot molds.

The unit as built is estimated to give a production of one mold about every fifteen minutes. This of course will vary with mold size. From tests it was found that a large steel shot abrasive propelled by 100-psi air would remove all "kish" and other accumulations of material after a cast. It was also noted that the blast supplied a certain amount of shot peening to the sur-

face. This is expected to close the fine fire cracks through cold working of the metal surface and prevent their propogation thus prolonging the mold's useful life. The process will do such a good job that molds will in all probability only require cleaning after every fourth or fifth cast.

This machine will soon start operations and it will take at least six months to secure operating data. The author, however, can at this time furnish designs which have been worked out to clean all types of molds in use or as cast and supply fairly accurate operating costs.

MISCELLANEOUS

The main applications of mechanical blast cleaning process in the steel industry have been discussed. There are, however, several special operating installations of considerable interest.

Most engineers are familiar with the application of the process in preparing the surface of hot rolled material for galvanizing such products as culvert stock so there is no need to further describe this application.

We have three installations cleaning pipe skelp; two of which cleans the edge of the under side to provide a virgin metal contact for electricweld pipe. The other cleans strip all over in a slitting line which produces narrow widths for the production of small diameter, heavy wall electricweld conduit.

There is one large installation etching cold roll steel prior to cladding. This is a new process and further information cannot at this time be given.

A company manufacturing copper clad steel wire is operating a machine to prepare the steel core for cast cladding. It is very successful and replaces their old acid pickling equipment.

One of the largest mills has just installed a unit to remove the glass skin and scale from hot extruded steel shapes.

In addition, there has been considerable work on special finishes for subsequent processing and for finished products.

AISE
WEST COAST MEETING
San Francisco, California
March 21, 22, 23, 1955
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PLAN TO ATTEND

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NOW!

A Power Plant Report to Management

By STANLEY A. NELSON
Supervisor of Plant Engineering
Deere and Co.
Moline, Ill.

. . . . records and reports are important tools in power plant operation . . . .

▲ HOW many engineers prepare an annual report to management on the operation of power plants and the consumption and cost of utilities? Those who do not probably wonder why they should have to do that if their plant produces all the steam, electricity, compressed air, refrigeration or other services needed. Actually there are many plants that had no idea what quantities of utilities they produce or how much it costs to produce the various services. Some of these power plants are out of existence now or have become just plain heating plants because the management did not know their value.

Perhaps we can best break this paper down into four principal questions to be answered. They are:

1. Why keep records and make reports?
2. What should go into records and reports?
3. When should records and reports be available?
4. What should be done with them?

Since the industries represented here are quite diversified and locations are scattered geographically, individual requirements will vary considerably. Generally, however, most power plant operations follow a similar pattern quite closely. In presenting this discussion, the records and reports are referred to as power plant records and reports rather than boiler plant records since most of the power plants in our organization contain in addition to boilers and their accessories, steam and electric driven air compressors, electric power generation equipment, and steam driven raw water pumping facilities.

1. *Why keep records and make reports?* Some plants keep practically no records and as a result have not the slightest idea of what it costs to produce steam, electricity, compressed air or other services. It is because of this lackadaisical method of operating industrial power plants, that it has been possible for public utility companies to come in and replace profitably operated privately generated power with that purchased from their companies simply because the engineer in charge did not know accurately what the cost was of the power he produced.

For example, at a large millwork company in our locality, the power plant was set up to burn the waste wood and saw dust using the steam produced to generate most of the factory's power requirement and supply all of the heating steam needed. Under such circumstances, the power cost was very low, even though the turbo-generator was a condensing unit with no provision for extracting steam for heating. Yet the plant contained absolutely no instrumentation except a steam gage on each boiler and a few indicating electrical meters. They had no idea of how much steam was produced, how much steam was used for heating, or even how many kilowatt hours of electricity were generated nor did they have any record of costs. The old chief engineer always complained that he could never get his manager to approve new equipment so he continued to patch and repair the machinery he had. Finally the local power company sold the management on buying all the power and only operating the turbo-generator on rare occasions when they could not dispose of the refuse in any other way than burning it. Yet in all the years of its operation the only coal that was ever burned was during some severe winter weekends when there was not enough wood waste available.

Unless one has sufficient information regarding the cost of power produced by ones own equipment, it is quite easy for a utility company to build up a case against privately produced power and sell management on the idea of how much cheaper it is and how nice it is not to have the responsibility. In our company, we carefully evaluate the cost of power produced by our own generation (including all prime movers such as steam-driven air compressors and raw water pumps), giving due credit for the process and heating steam obtained from the engines or extraction turbo-generators. The remaining cost of the power produced is then compared with the cost of purchasing the equiv-

alent amount of power on the most favorable rate available to us. Our management has found these savings great enough to invest several million dollars in power generating equipment, at a time when the trend is otherwise in most industries. Since World War II, we have installed over 28,000 kw in power generating capacity which is a considerable amount for the relatively low power requirement of the farm machinery industry.

Power Plant Log Date

	Hrs. Run	METER READING A. M.	P. M.	Multiplier	QUANTITIES A. M.	Day	P. M	TOTAL
Boiler No.								M. Lbs.
Boiler No. 2								M. Lbs.
Boiler No. 3								M. Lbs.
Boiler No. 4								M. Lbs.
Total Steam								M. Lbs.
Coal No. 1								Tons
Coal No. 2								Tons
Coal No. 3								Tons
Coal No. 4								Tons
Total Coal								Tons
Evaporation								Lbs.
Boiler Feed								M. Lbs.
Softener—1								M. Lbs.
Softener—2								M. Lbs.
City Water								M. Lbs.
Spill Water								M. Lbs.
Total Makeup								M. Lbs.
Makeup %								M. Lbs.
F. W. Treatment								Lbs.
H. P. Steam Out								M. Lbs.
Steam to Gen.								M. Lbs.
Returns								M. Lbs.
Compr. 1								M. C. F.
Compr. 2								M. C. F.
Compr. 3								M. C. F.
Compr. 4								M. C. F.
Total Air								M. C. F.
Shop Air								M. C. F.
Foundry Air								M. C. F.
Total Air								M. C. F.
Pur. Max. D								
Pur. Power								K. W. H.
Gen. No. 1								K. W. H.
Gen. No. 2								K. W. H.
Gen. No. 3								K. W. H.
Total Power Gen.								K. W. H.
No. 1—Circuit								K. W. H.
No. 2—Circuit								K. W. H.
No. 3—Circuit								K. W. H.
No. 4—Circuit								K. W. H.
No. 5—Circuit								K. W. H.
No. 6—Circuit								K. W. H.
No. 7—Circuit								K. W. H.
No. 8—Circuit								K. W. H.
Total Power								K. W. H.
Outdoor Temp.		°F.	°F.	°F.	Steam per K. W. H. (1000 C. F. Air=2 K. W.)			Lbs.
Barometer		In. Hg.	In. Hg.	In. Hg.				

		COAL Tn.		ENG. OIL Gal.	STEAM CYL. OIL Gal.	AIR CYL. OIL Gal.
On Hand 7:00 A. M.						
Received						
Total						
Consumed						
On Hand 7:00 A. M.						

M1602-5M-7-51-Stock

PUT REMARKS ON OTHER SIDE OF SHEET

Figure 1 — The daily power plant log reports are due on the day after operations.

To illustrate, recently it was necessary to consider additional boiler capacity in one of our plants in order to meet the increased heating demanded by the addition of several large buildings. Studies showed that rather than install an additional 225-psi boiler with a capacity of 185,000 lb of steam per hour and increase the size of our connection with the local utility company to supply the ever increasing electrical load, considerable savings would be gained by substituting an 825-psi boiler of the same capacity and a 7500-kw turbo-generator equipped to bleed-steam at 225-psi for topping the old power plant and also extracting at 5 psi to supply the low pressure heating system. The survey showed that the additional cost of the high pressure boiler and turbo-generator over the minimum installation was $800,000 and that based on the then existing demands this added investment would be repaid in "out of pocket" savings in just four years. Future increases in loads will naturally accelerate the savings.

Most plants are required to set up some sort of a budget covering the cost of supplying steam, compressed air, electricity, etc., to the factory. Unless you keep a running record of costs, quantities, efficiencies and the like, it is difficult to make reasonable predictions regarding the budget for operating a power plant or boiler plant. Past requirements based on units of

plant production will permit careful estimating of quantities of utilities required and their costs to meet a given production schedule.

Information obtained from power plant records can be invaluable in determining whether older pieces of equipment should be retired and replaced with modern units or whether additional facilities are needed. If actual costs and performance records are available

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UTILITIES AND FUELS REPORT

DEERE & COMPANY

_____ Plant

For Period _____ to _____

Month _____

Weeks _____

Year _____

FACTORY REQUIREMENTS

Tons of Finished Products		Tons	Total Cost—Utilities		$
Total Power Consumed		KWH	Max. Demand		KW
Total Compressed Air		MCF	Max. Demand		CFM
Total Steam to Factory (Cond. Returns)		M#	Raw Water to Factory		M. Gal.
City Water	M. Gal.	$	Factory Gas	MCF	$
Fuel Oil	M. Gal.	$	Propane	M. Gal.	$

POWER PLANT DATA AND REQUIREMENTS

Gen. Power (Steam)		KWH	Total Steam Produced		M#
Gen. Power (Diesel)		KWH	Diesel Oil	Gal.	$
Gen. Power (M.G. Sets)		KWH	Feedwater Makeup		M#
Power Used by Aux.		KWH	Steam Used by Aux.		M#
Purchased Power (Energy)	KWH	$	H.P. Steam to Factory		M#
Purchased Power (Demand)	KW	$	Turbo-Gen. Cond. Returns		M#
		$	Coal Used	Tons	BTU/#
Purchased Power Total Cost		$	Oil Used	M. Gals.	BTU/GAL.
Compressed Air (Steam)		MCF	Gas Used	MCF	BTU/CF
Compressed Air (Elec.)		MCF			

POWER PLANT COSTS

A/C No. POWER PLANT ONLY	ENGINE ROOM Labor	ENGINE ROOM Mat'l	ENGINE ROOM Total	BOILER ROOM Labor	BOILER ROOM Mat'l	BOILER ROOM Total	POWER HOUSE TOTAL
55 Bldgs.—Grounds							
58 Maintenance							
85 Miscellaneous							
86 Engr.—Firemen							
87 Fuel							
88 Lubrs.—Waste							
92 Insurance							
94 Depreciation							
TOTAL.....	$	$	$	$	$	$	$

OUTPUT SOLD

To			To		
Steam	M#	$	Steam	M#	$
Air	MCF	$	Air	MCF	$
Power	KWH	$	Power	KWH	$
Fixed Charges		$	Fixed Charges		$
TOTAL		$	TOTAL		$

Figure 2 — The utilities and fuels report is the key report for management in controlling utility costs.

these will help immensely in selling such projects. Generally speaking, management is only interested in two things from a power plant. First, and most important, is continuous operation and, second, is the lowest possible cost of utilities. How to accomplish these two important conditions is entirely up to each individual engineer but unless he has sufficient records to prove his case it will be difficult to sell management on the need for new equipment or improvements. They are usually willing to listen when one can prove from data and figures supplied from the power plant records and the accounting department, the need or monetary desirability of a project.

Information gained from the various power plant records should assist the operators and chief engineers in maintaining optimum efficiency of operation. Unless operating data is reviewed carefully and adjustments made as the data shows to be required, there is not much need of keeping power plant records. A continually improving report given to the management enhances the engineers standing with his employer.

2. *What should go into records and reports?* What information should a power plant report contain? This part of the discussion is divided into several sections since there are a number of types of reports required in the operation of power plants. Most of our power plants have three basic sets of reports: (1) engine room and boiler room log sheets upon which hourly or peri-

odic readings are entered, (2) a daily log sheet for the power plant, (3) a monthly utilities report which is submitted to the central engineering department for further review and from which data is assembled to prepare the annual power plant report to management.

The engine room and boiler room log sheets are reports made by the operators to the chief engineer. It is considered of prime importance to have daily log sheets upon which periodic readings of certain pertinent information such as steam pressure, water pressures, air pressures, water temperatures and the like are entered. These entries along with flow recordings and consumptions, give the operators an indication of whether the equipment is performing properly and what the loads are. This data in turn should guide them as to what pieces of equipment are to be operated in order to obtain optimum efficiency.

Reviewing these reports daily, the chief engineer should note any irregularities or trends which might suggest preventive maintenance to keep equipment in operation. A steadily climbing oil temperature for instance, might indicate the fouling of an oil cooler or an excessive pressure drop at a given point could point out the fouling of a pipe line or strainer. By careful analysis of the data, the person in charge can schedule preventive maintenance and thus eliminate costly shutdowns.

These sheets should be carefully screened to eliminate any data which is not essential to the operation of the plant or to the scheduling of equipment operation or maintenance. It does no good to have operators enter figures on a log sheet without knowing the meaning of them. Be sure the operators know what the figures represent so that they can make needed adjustments to equipment as certain conditions change. Here again, unless the operator knows what to do when various conditions arise, the information is of very little use to him.

From the data assembled on these log sheets and information supplied from meter readings at shift changes, the daily log sheet (the blue ruled form) is made up. Information is broken down on a three shift basis. These shift loads vary considerably from one factory to another and from one season to another. This shift data serves as a guide as to how power plant equipment should be operated and whether it is profitable to generate or purchase power during certain times of the day. These power plant log sheets are to be filled in daily to give a running record of information contained therein. The form displayed is used by two-thirds of our plants since it is fairly universal in form. Some of our larger power plants have their own special forms which include all of the necessary data for that particular plant. Each individual industry would have to work out a form suitable for their own requirements since they do vary considerably.

Each of the factories submit the data contained on the utilities report (the green ruled form) monthly to the central engineering department in our organization. The power plant supplies the quantities of the various utilities produced and the accounting department enters the cost of operating the power plant and purchasing utilities as well as the plant production output. A copy of the report permits the chief engineer of the power plant to review his monthly costs of maintenance, fuel, labor, lubricating oil, fixed charges, etc., and to determine whether or not his operations are in line with his budget or as economical as he could expect. The monthly report permits the factory management to note the utilities consumed as compared with factory production. The central engineering department reviews the report, checks efficiencies and determines costs on a unit basis. If the costs or efficiencies are not in line, the man in charge is usually requested to explain the reason for such variations.

From the information supplied on these monthly reports, an annual report is made up at the end of the fiscal year for each factory, copies are submitted to the management of the respective plants and to the vice president in charge of the operations of that particular factory. This report ties in the power plant operation and other utilities requirements with the production of the factory and gives the management an indication as to whether they are being extravagant in the use of utilities compared with production output. It also carries a comparison of consumption and costs with previous years to be able to detect trends such as increased production needs, wasting of utilities or increased costs. This report carries most of the pertinent information that management desires for reviewing the costs of heat and utilities, and the engineer for watching performance.

The results of all of our power plant operations are compiled into a consolidated annual report so that power plant operations and utility costs can be compared between factories. This report is distributed to the president, vice presidents in charge of factory operations, factory managements, plant engineers, and power plant chief engineers. From this report the engineers then carefully review their standing with reference to the other factories, and compare costs and operational data. In this manner it does create somewhat of a competitive spirit between our plants. In making such comparison, local conditions such as age of equipment, climate, and such must be recognized which influence operational results and costs. Similar plants in nearby localities afford quite accurate comparisons.

In all cases, the amount of report material has been boiled down to a minimum, by continually screening report forms to eliminate duplication and unnecessary information. Report forms should be changed as needed to include only the data desired. It is only by keeping reports concise and useful that they are of any value to the company. Do not forget that an executive's time is valuable.

3. *When should records and reports be available?* When should reports be made out? This is a very important question, and one which occasionally causes considerable embarrassment. To be of value in guiding the operation of a power plant, the reports must be made available promptly. The daily readings submitted by the operators from the boiler room and engine room log sheets should be translated to the daily power plant log sheet on the following morning by the chief engineer so he can review his operations, efficiencies, demands, etc., before the information gets stale. For example, if he finds that his boiler efficiency has drop-

ped off, he is then in a position to make adjustments early enough to maintain a high average efficiency.

The monthly report should be completed by both the power plant staff and the accounting department just as soon as possible after the end of the month so that the chief engineer of the power plant can review his costs before too much water has gone over the dam. We have had cases where the power plant engineers and the accounting departments have been guilty of leaving reports go for several months at a time, and then sit down and work out a number of reports and submit them to the central engineering department. This matter is called to their attention, because the reports have little value except for historical data if they are submitted as much as a month late.

The annual reports are put out as early as possible after the close of the fiscal year, in order to give the officials of the company who are interested in this data the year's results. This also helps the engineers by giving them comparison sheets for which they can base future operations.

4. *What should be done with them?* What should be done with the reports? Do not just file them away for future scrap paper drives. Keep in mind that the only purpose of a report or record is to pass on information to someone else who is interested and who can use the data to a good advantage. Except for having a historical record of operations which we keep in the central engineering department, records and reports can usually be destroyed after a five to ten year period since they will only take up file space after that. Conditions usually change to such an extent that beyond such a period the information has relatively little effect on future operations.

The operators should be trained to watch their entries on the log sheet and note irregularities that might cause trouble in operation. They must be cautioned to be sure and actually take all readings and be severely disciplined if caught making entries without taking actual observations. Not long ago an operator neglected to take readings in one of our plants on a Sunday morning. Instead he sat at his desk and entered normal readings on the log sheet. Suddenly he found a generator overheating with a partial load. The unit was shut down and considerable time spent in checking for grounds but nothing could be found wrong. After a day during which production was partially curtailed, he finally admitted he had not been to the basement of the power plant all morning prior to the incident and that when he got there he found a water circulating pump stopped which supplied water to the generator air cooler. The man was discharged for negligence.

The chief engineer should watch the daily log sheets and note the performance and requirements in order to be able to judge the best selection of equipment to operate. He should also carefully analyze costs at the end of each month and then do whatever is necessary to adjust his operations and reduce these costs if possible. He should always be in a position to answer questions about his operations.

Careful study of the reports submitted will assist a plant engineer in predicting future demands so that he can determine what additional facilities will be required to meet coming production. On the basis of the cost figures he can determine what economy can be effected by the installation of new and more modern equipment. If equipment is installed on a savings basis, then by means of the record, a proof can be worked up making actual comparisons to satisfy yourself and your management. Remember that management is primarily interested in getting the most for a dollar spent. There is an old saying that an engineer is a person who can do with one dollar what any fool can do with two. Make your reports prove it.

Another point which should not be lost sight of is the fact that even though records or the manner of measurements are not 100 per cent correct, it is far better to have a 90 per cent correct record to work from than to have none at all. It can be shown in many cases that even where costly recording equipment has been installed, the records are never 100 per cent correct. We have not found it necessary to spend any unusual amounts of money to maintain our record system.

In conclusion, may we summarize this paper by saying:

1. Why keep records and make reports? Simply to know what we are doing and to be able to prove to ourselves and our employers that we are doing the best job possible.
2. What should go into the records and reports? Only the minimum information that is necessary for guiding the operation and maintenance of a power plant or service.
3. When should the records and reports be available? Just as soon as possible after the data is made available.
4. What should be done with them? Study them.

DISCUSSION

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H. E. RAAFLAUB, Combustion Engineer, Steel Div., Rouge Plant, Ford Motor Co., Dearborn, Mich.

JOHN J. ALEXANDER, Superintendent, Electric Power and Steam, Republic Steel Corp., Cleveland, Ohio

N. R. Kirkdoffer: Those in the utility or plant service divisions of steel mills will agree that the production people look upon us as a liability rather than an asset. We do not reduce the ore, make, shape, roll or ship the steel. All we do is to supply the necessary air, water, steam and electric power for the various processes. However, when it comes to service recognition, how many of us, as we sit in our homes, give the public utility organization a thought other than during a utility interruption. The same is more or less true with the production personnel of our plants. Therefore, as Mr. Nelson states, the positive way to keep management aware of our needs relative to maintenance, reserve, expansion and efficiency, is through records and reports.

At the power plants of Inland Steel Company we have been keeping records like those mentioned in the paper for years and they have been very valuable. The records are certainly the backbone of power house efficiency, great aids for indications of needed maintenance and a must for expansion planning or capacity increases. We too have found that by formulating turn data a competitive spirit between plants and crews is created.

We also keep our management aware of our power generating system by what we call a trend chart. The chart consists of three curves.

1. One showing our generating capacity in kw.
2. A second shows the average kw load for the month.
3. A third shows the average kw load for the highest 8-hour turn of the month.

This chart starts with the year 1943 and is kept currently each month. We have found this type of chart very enlightening.

In our plant, electrical energy is the only utility of which the major portion is metered at the point of consumption. For the remaining utilities, steam, water and air, the amount used by each consumer is based on an engineering estimate relative to a unit of production.

How does our practice compare with that of others?

Stanley A. Nelson: We use practically the same system. We do not try to meter the utilities supplied to the various departments but we do in many cases estimate requirements. We have in our factories in most cases two factories within a factory. Our foundry operations in all cases are treated as a separate one. We do meter all of the services to the foundries separate from the factory, but otherwise we generally estimate the services as mentioned.

H. E. Raaflaub: In discussing this paper, I will tell how the steel division of the Ford Motor Company Rouge Plant reports the fuel and utilities picture to management. It is similar to the points which Mr. Nelson discussed in the presentation of his paper. The Rouge power plant supplies power and other services to the divisions within the plant and it is a unit managed separately from the steel division. Power, steam, water and other services are purchased from them. Monthly quantities for our division are sent to our accounting department where the pricing is checked and then these billings are forwarded to the fuel and utilities section of the plant engineering department. These billings are based on meter readings from meters which are placed in the main lines and substations to our division. The fuel and utilities section distributes these charges to the various departments within the division. The quantities of the fuels which we sell and distribute within the plant are forwarded to the accounting department and the fuel charges are then distributed departmentwise and plant wide to other divisions. All of this data is compiled as soon as possible after the month ends and the fuel and utility data is usually in report form within five or six days. This monthly report, containing year to date data with the previous years average data, is distributed to the:

1. Vice-president of operations.
2. General manager of steel division.
3. General production manager of steel division.
4. Manager of plant engineering.
5. Production manager.
6. Rouge staff engineering.
7. Department operating managers.

This fuel and utilities report covers: (1) all furnace performance operations on a tonnage and Btu basis, (2) fuel and utility usage on a Btu and quantities basis for the coke oven, blast furnace, melting, and rolling divisions.

This monthly report does the following:

1. Assists management in the yearly budget.
2. Assists in the annual fuel and utilities report.
3. Allows operating managers to review their fuel and utilities costs against their production output.

During the last five or six years, the everexpanding facilities at the Rouge Plant have increased the load on the main power plant and it has been necessary to install new boiler and auxiliary equipment. This could not have been done if the proper records had not been maintained and analyzed.

Over the last 34 years since the construction of the Rouge power plant, the Ford engineers have replaced or are replacing all except one of the original boilers. The original capacity has been nearly quadrupled. Dollars and cents facts properly presented to management resulted in decisions to modify the equipment for the future.

In designing new power plant equipment, proper instrumentation is essential to correctly analyze performances. The money spent for such instrumentation eliminates repetitive test work by the engineering staff. Therefore, good instrument application is worth while.

In conclusion, I wish to ask Mr. Nelson—what other means of training do you have for the operators other than on-the-job training?

Stanley A. Nelson: We do not have any other training than on-the-job training for operation. The men are brought up from the ranks of the power plants.

John J. Alexander: Mr. Nelson's statement that his management had invested several million dollars in power generating equipment and had increased the generating capacity by 28,000 kw is ample evidence of the value of complete records and reports of power plant performance.

While I agree that careful log sheets should be kept, I have not found this data to be normally reliable for accurate determination of plant performance.

We have found it desirable to have charts and log sheets checked daily by a test engineer who prepares a daily summary sheet of plant performance. Questionable log sheet data or charts are checked and corrected to provide reasonable accuracy for daily performance of each power station.

The time of chief engineer is usually devoted to training of operating and maintenance forces, supervision of plant operations to obtain reliable and economical performance, and scheduling maintenance of equipment. The test engineer prepares daily and monthly performance reports for review by the chief engineer before submitting the data to management.

I agree with Mr. Nelson's conclusions but have not found the preparation of accurate plant performance reports as simple and easy as implied by his paper.

TENTATIVE PROGRAM

ASSOCIATION OF IRON AND STEEL ENGINEERS

WESTERN MEETING

ST. FRANCIS HOTEL
SAN FRANCISCO, CALIFORNIA

March 21, 22, 23, 1955

Monday, March 21

9:00 am and 2:00 pm — Technical Meetings

Tuesday, March 22

9:00 am and 2:00 pm — Technical Meetings

Wednesday, March 23

Inspection trip to the Pittsburg Works, Columbia-Geneva Steel Div., United States Steel Corp., Pittsburg, Calif.

7:00 pm — INFORMAL STAG DINNER

PAPERS AND AUTHORS

"Electronics and Magnetic Amplifiers and Their Application," by John W. Fox, Manager, Applied Engineering, Clark Controller Co., Cleveland, Ohio.

"Special Problems of Waste Disposal in the Steel Industry," by T. F. Barnhart, Senior Process Engineer, Chemical Plants Div., Blaw-Knox Co., Pittsburgh, Pa.

"Ventilation of Steel Mill Electric Equipment," by S. L. Jameson, Construction Engineering Section, General Electric Co., Schenectady, N. Y.

"C. F. and I. 3-Strand High Speed Rod Mill," by V. W. Johnson, Superintendent, Rolling Mills and Finishing, Colorado Fuel and Iron Corp., Pueblo Plant, Pueblo, Colo.

"Solving Ingot Molding Problems on the West Coast," by J. B. Klukkert, Assistant Superintendent, Foundry, Kaiser Steel Corp., Fontana, Calif.

"Reversing Hot Strip Mill . . . Its Place in the Steel Production Facilities," by David Lyle, Vice President, Continental Foundry and Machine Co., Pittsburgh, Pa.

"Normalizing and Annealing of Steel Products," by James MacGregor, Board Chairman, York-Gillespie Manufacturing Co., Pittsburgh, Pa.

"The Extrusion of Metals," by G. A. Moudry, Chief Metallurgist, Harvey Machine Co., Inc., Torrance, Calif.

"Report on Arc Furnace Future," by Frank Nickolson, Engineer, Swindell-Dressler Corp., Pittsburgh, Pa.

"First Cost vs Maintenance Cost of EOT Cranes," by William A. Perry, Assistant General Superintendent—Service, Inland Steel Co., East Chicago, Ind.

"The Scope of the Furnace Fume Control Problem," by H. L. Richardson, Research-Cottrell, Inc., Pittsburgh, Pa.

"Continuous Casting at Atlas Steels Ltd.," by John F. Black, Manager, Continuous Casting Section, Freyn Dept., and F. W. Rys, Assistant Manager, Freyn Dept., Koppers Co., Inc., Pittsburgh, Pa.

"Application of Rotary Hearth Furnace for Heating Plate Mill Slabs," by F. C. Schoen, Chief Engineer, Alan Wood Steel Co., Conshohocken, Pa.

"Methods to Increase Open Hearth Production," by G. W. Teskey, Jr., Open Hearth Superintendent, and W. L. Murphy, Fuel Engineer, Bethlehem-Pacific Coast Steel Corp., South San Francisco, Calif.

"Control Systems Utilizing Non-Contacting Thickness Gages," by W. E. Van Horne, Assistant to Executive Vice President, Industrial Nucleonics Corp., Columbus, Ohio.

"Reel Control Systems for Mills and Process Lines," by A. J. Winchester, Jr., Industry Engineering Dept., Westinghouse Electric Corp., East Pittsburgh, Pa.

HOTEL RESERVATIONS

Write direct for hotel reservations to St. Francis Hotel, San Francisco, Calif., giving time of arrival and type of accommodations desired. Reservations should state that they are for AISE Western meeting.

TRANSPORTATION

Individuals or groups desiring assistance in planning their trip should get in touch with the office of American Express Co., in their respective cities, or with any local travel agency.

PLANT VISITS

Members of the AISE who wish to visit steel plants when attending this meeting should make arrangements for such visits directly with the plants involved.

ELECTRICAL FEATURES
of Universal Slabbing and Hot Strip Finishing Mills at Fairless

By WARREN REID
and
R. H. WRIGHT
Steel Mill Engineers
Metal Working Section
Westinghouse Electric Corp.
East Pittsburgh, Pa.

. . . . unusually high power features the main drives on the slabbing and hot strip mills . . . .

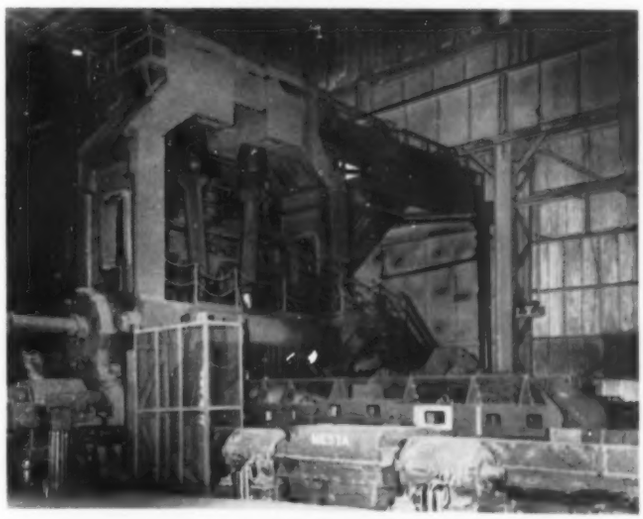
▲ THE universal slabbing mill and the hot strip mill finishing train at the United States Steel Corp.'s Fairless Works have many unique features. The purpose of this paper is to describe the two installations, to give the reasoning behind the selection of the electrical equipment, and to point out some of the unique electrical features.

THE UNIVERSAL SLABBING MILL

The selection of the main drive motors for the universal slabbing mill was, to some extent, based on experience with previous type mills. The first electrically driven reversing mill in this country was a 30-in. universal plate mill installed in the Chicago area in 1907. It consisted of two 2000-hp, 100/150-rpm, direct-current motors on a common shaft, and supplied from a flywheel motor-generator set. The twin drive arrangement did not make its appearance until 1930 when a 54-in. blooming mill was installed in the Chicago area. This mill is driven by two 5000-hp, 40/80-rpm double-armature motors. In 1938, a 45-in. universal slabbing mill was installed in the Pittsburgh area. The horizontal rolls are driven by two 5000-hp, 40/80-rpm motors and the edger rolls are driven by a 3000-hp, 60/180-rpm motor. This mill has produced good tonnages but experience indicated that even greater tonnages could have been produced if additional horsepower had been available.

Therefore, when the 45 x 90-in. universal slabbing mill at Fairless was being considered, it was decided to increase the power for the horizontal rolls to 12,000-hp at 40/80-rpm and the power for the edger rolls to 4000-hp at 60/150 rpm. The combined maximum torque capacity of the horizontal rolls driving motors is 4,330,000 lb-ft, which is 20 per cent higher than used before, and the maximum torque capacity of the edger rolls motor is 962,500 lb-ft, which is 33.3 per cent higher than that previously used. A general view of the mill is shown in Figure 1.

Figure 1 — The 45 by 90-in. universal slabbing mill is viewed from the operator's side.



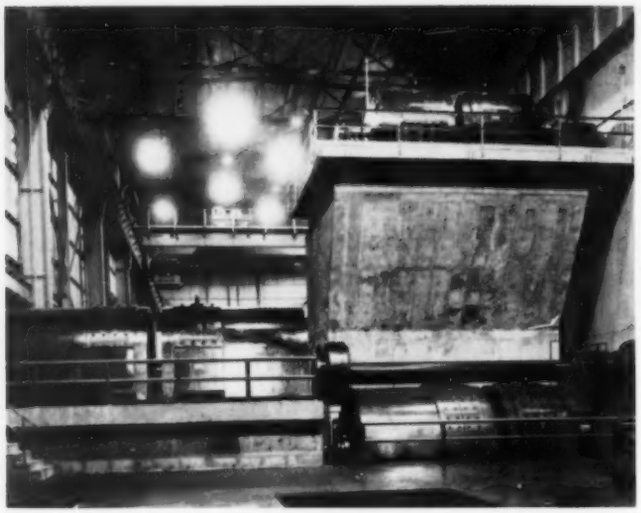


Figure 2 — Main drive motors for the universal slabbing mill have a total of 16,000 hp.

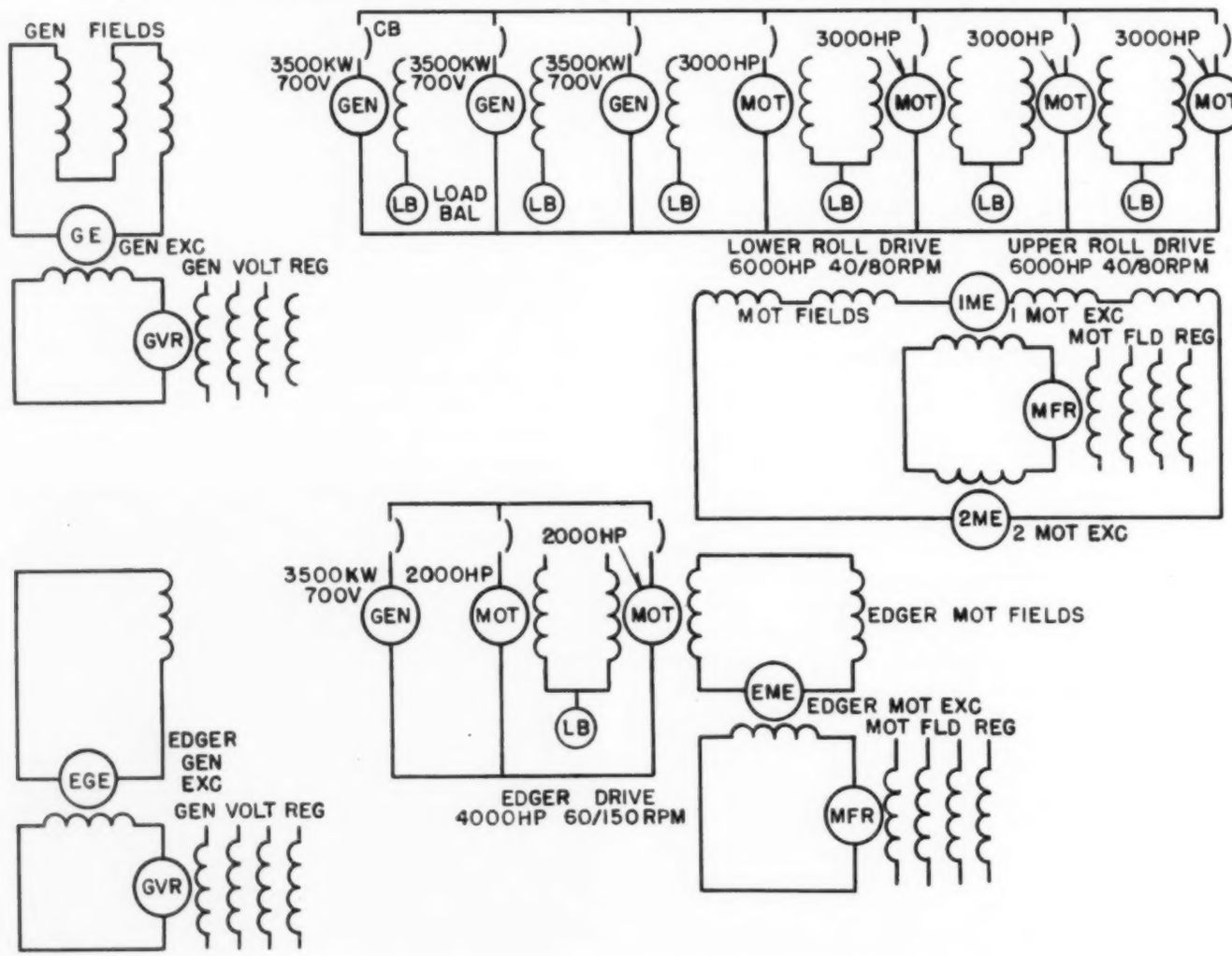
The 12,000-hp for the horizontal rolls consists of two 6000-hp, double-armature motors in a twin-drive arrangement. Such an arrangement results in a lower inertia, thus permitting a faster reversal time; and also decreases the center line distance between the output shafts to a minimum. The 4000-hp for the edger rolls consists of a double-armature motor which in addition to allowing a faster reversal, also permits a reduction in the horizontal distance between the horizontal rolls and the edger rolls. The physical arrangement of the horizontal and edger rolls driving motors is shown in Figure 2. The overall length of the twin drive motors is 62½ ft. The center line distance between the output shafts for the horizontal rolls is 94¼ in. The horizontal distance between the output shafts for the horizontal rolls and the shaft for the vertical rolls is 8 ft 3 in.

Previous installations of this type have often had common bus arrangements for the main drive motors and generators, and several such arrangements were considered for the Fairless mill.

One arrangement, shown in Figure 3, would have consisted of three 3500-kw generators operating in parallel to supply the four 3000-hp armatures for the horizontal rolls and another 3500-kw generator to supply the 4000-hp double-armature edger motor. Such an arrangement would have required individual circuit breakers for each motor armature and each generator and would also have required provisions for balancing the loads in the various parallel circuits. The 3500-kw generators would have limited the speed of the flywheel motor generator set to 360-rpm.

Another arrangement considered, as shown in Figure 4, would have consisted of four 2500-kw generators

Figure 3 — This alternate armature circuit arrangement was considered for the universal slabbing mill.



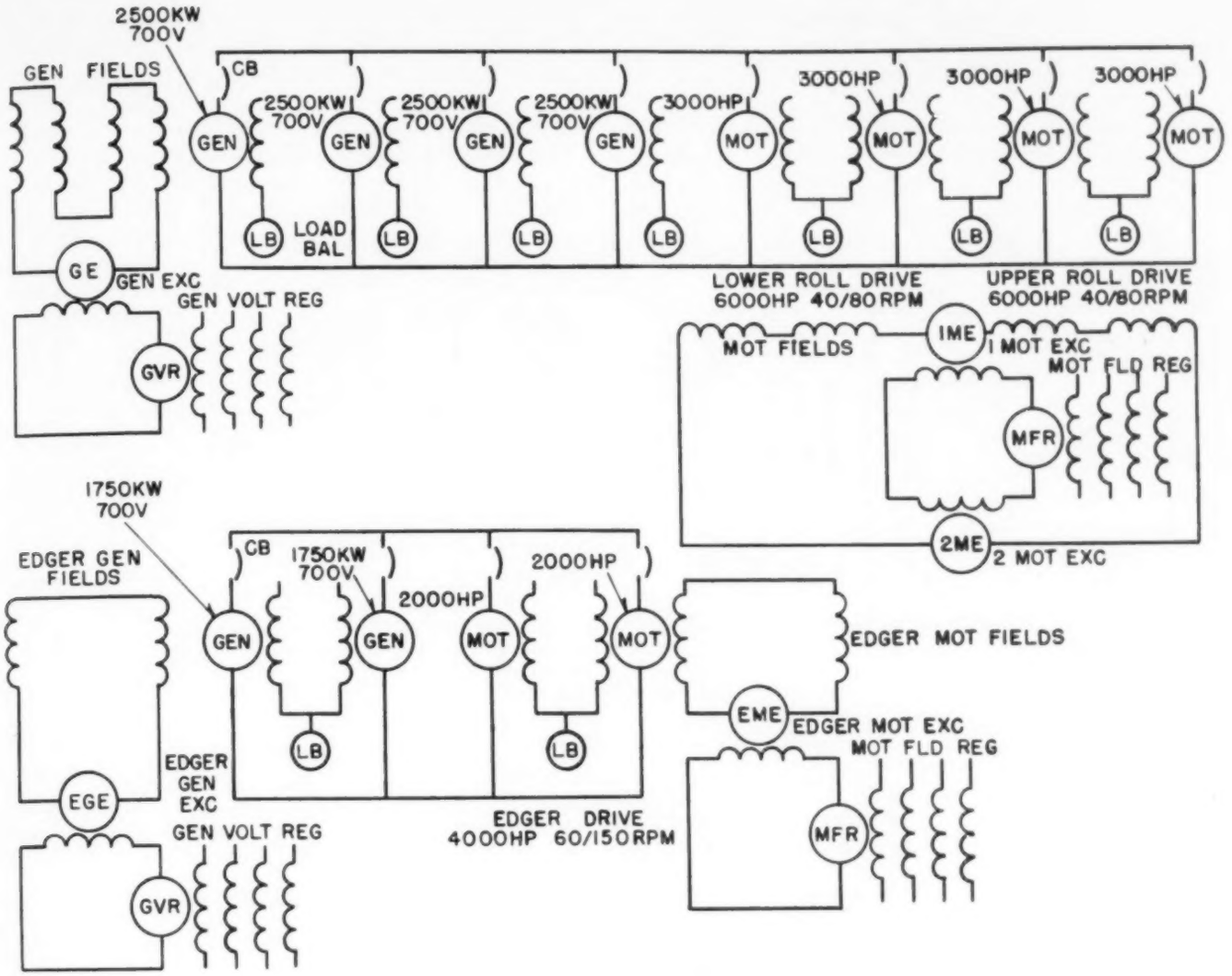


Figure 4 — Another possible armature circuit for the slabbing mill.

operating in parallel to supply the four 3000-hp armatures, and two 1750-kw generators to supply the 4000-hp edger motor. This arrangement would have permitted increasing the speed of the flywheel motor-generator set to 514-rpm, but would have required even additional circuit breakers and load balancing equipment.

The arrangement selected, as shown in Figure 5, employed the four 2500-kw and the two 1750-kw generators, but the connections of the armature circuits are such that two 3000-hp and two 2500-kw generators were connected in a series-sandwich loop circuit for the upper horizontal roll drive; a duplicate arrangement was used for the lower horizontal roll drive; and two 1750-kw generators and the two 2000-hp edger motor armatures were connected in a similar series-sandwich loop circuit. Series-sandwich circuit arrangements have been used for many years in the electrical industry, but this particular installation is unique in that it marks the first time that three separate loop circuits have been employed for the main drive circuits for a mill of this type. As compared to either of the common bus arrangements described previously, the three loop circuits have three distinct advantages.

1. Fewer circuit breakers are required.
2. The circuit breakers which are required need not have as high an interrupting capacity.
3. Only one load balancing circuit is needed.

The main flywheel motor-generator set is shown in Figure 6. The overall length of this set is 83 ft 4½ in. The flywheel is 14 ft in diameter and weighs 128,000 pounds. The control cabinet and the slip regulator for the motor-generator set driving motor is shown in the background. Auxiliary motor-generator sets and rotating regulators are shown in the foreground.

The shunt fields of the four 3000-hp armatures are supplied from two exciters arranged in a series-sandwich loop circuit. This arrangement permitted the use of small high speed exciters with fast response characteristics. The excitation of the two exciters is supplied by one regulator. This regulator has one field which is controlled by the mill operator, and other fields to provide for the automatic current limiting features. A similar arrangement is employed for the edger motor except only one exciter is used.

The shunt fields of the four 2500-kw generators are connected in series and supplied from one exciter. This exciter is in turn excited from a regulator which has

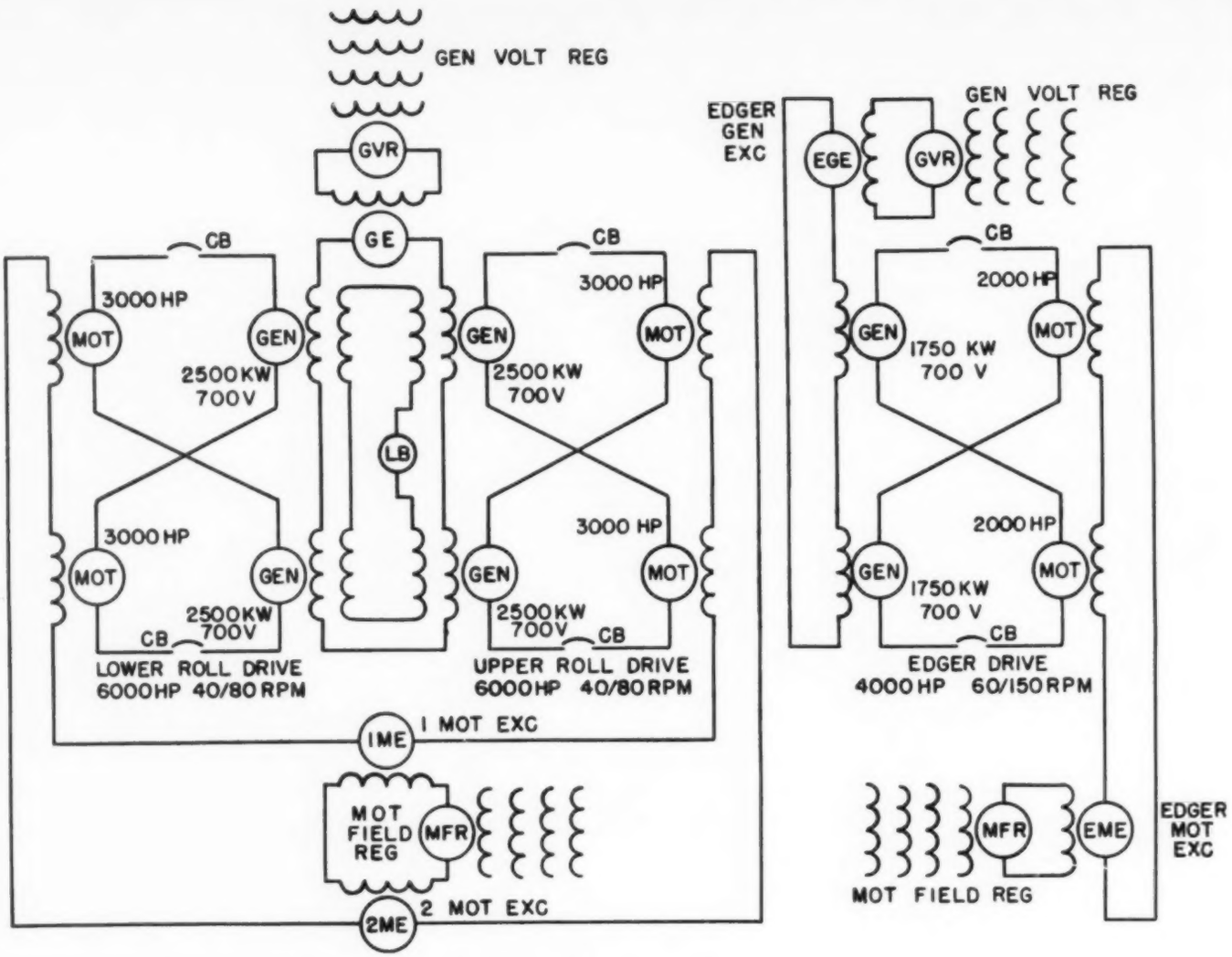


Figure 5 — Fairless universal slabbing mill schematic diagram shown is one finally adopted.

one field under the control of the mill operator and additional fields to provide for the automatic features of field forcing and current limiting. A similar arrangement is used for the two 1750-kw edger generators.

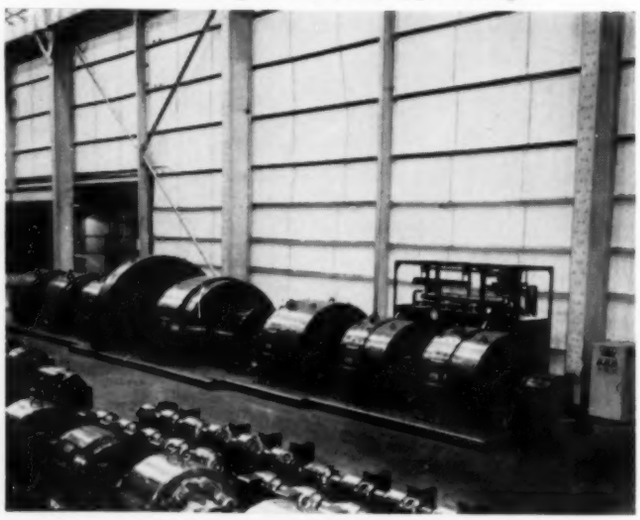
The excitation system can be adjusted to control the reversal time. The most practical reversal time is influenced by the rolling schedule and the inertia of the mill and table rolls. A base speed to base speed reversal time of 1.5 seconds has proven to be the most satisfactory for the Fairless mill. Response curves for the generator excitation system are shown in Figure 7.

The various points on the mill operator's master switch result in approximate speed matching between the horizontal and edger rolls. Rheostats, which control the edger motor field, are provided for more closely adjusting speed relationship due to changes in roll diameters.

The heavy slabs rolled in this mill could transmit considerable power between the horizontal and edger rolls. Since there is a relative large difference in the rating of their respective driving motors, the edger drive has been given a drooping speed characteristic to make sure that it does not carry more than its share of the load.

The mill tables, manipulators, manipulator fingers, horizontal roll screwdown, and edger roll adjustment are driven by mill type, adjustable-voltage motors. The various generators which supply these motors are divided into two duplicate motor-generator sets. If for some reason, one of these sets is out of service, the

Figure 6 — Flywheel motor-generator set for the Fairless universal slabbing mill is 83 ft 4½ in. long.



auxiliary drives can be kept in service by transferring them to the other set. However, under these emergency conditions, the speeds of the auxiliary drives are only one-half of their normal values.

Each auxiliary generator has a voltage regulator with a current limiting feedback circuit. Such a regulating system provides very fast acceleration and deceleration. At light loads the generator can be operated up to about 200 per cent of rated voltage. The current limiting feedback circuit limits the maximum current to about 250 per cent of the full load values. The schematic control diagram and the generator characteristics are shown in Figure 8.

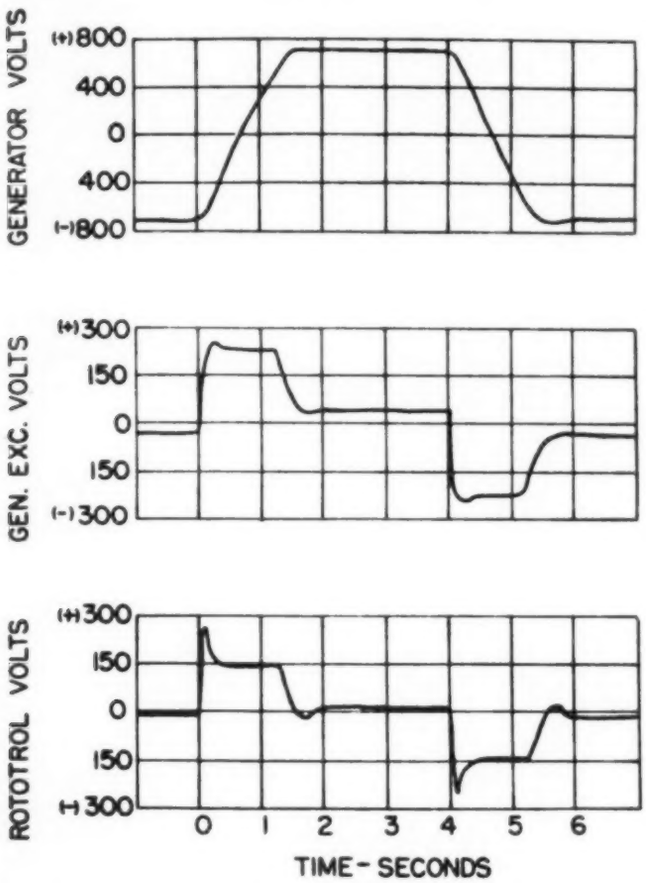


Figure 7 — Main generator excitation system response curve.

The method of adjusting the position of the edger rolls differs from that generally employed. Usually the positioning mechanisms are tied together mechanically or synchronized electrically. The Fairless mill has an independent, adjustable voltage motor for each mechanism. The position of each edger roll can be adjusted independently if the differential indicator shows that such an adjustment is required. Normally, the rolls are brought together or separated in unison by the use of a common master switch. Experience has shown that with proper adjustment of the control, any errors in alignment are negligible.

Another unusual feature of the Fairless installation is the arrangement of the two ingot cars. The ingot cars are cable-driven and operate on closely spaced parallel tracks. The unique feature is that each car has a cable at each end with a motor operated drum at each end of the track. The cables are held under tension at all times for either direction of travel to prevent contact of the cables with the track. The cars have a maximum speed of 1160-fpm. Pushbutton controls allow the operator to position the car at any pre-selected soaking pit. A schematic diagram of the electrical connections is shown in Figure 9.

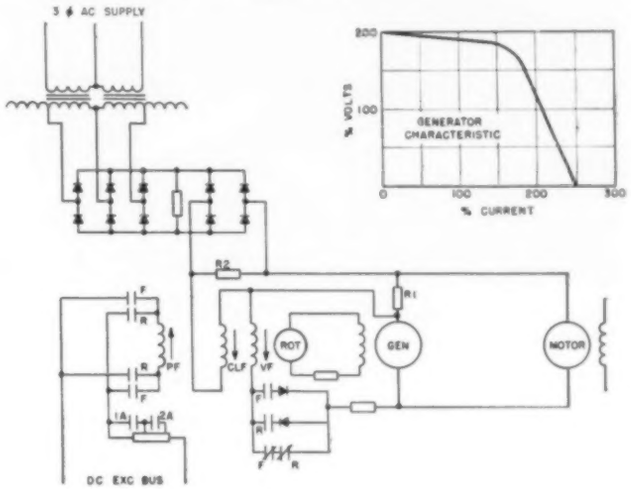


Figure 8 — Adjustable voltage auxiliary schematic diagram and generator characteristic.

THE HOT STRIP MILL FINISHING TRAIN

The 80-in. hot strip mill finishing train is unusual because of the large power concentration and the arrangement of the ignitron rectifier which supply the direct-current power. A total of 29,000-hp in direct current motors drive the six finishing stands. A general

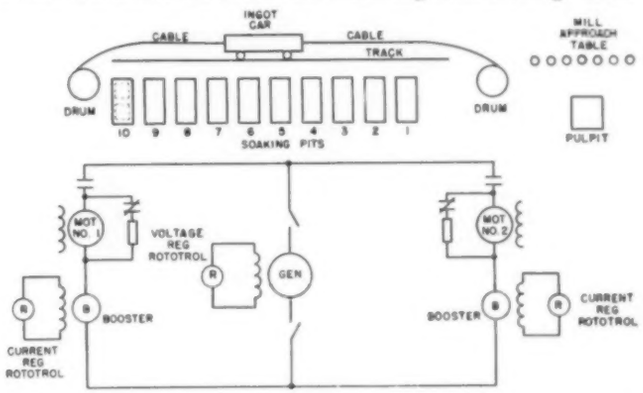


Figure 9 — Ingot car drive scheme with cables at each end of car is unique.

view of the finishing train is shown in Figure 10. The last stand is driven by a 4000-hp motor and all other stands by 5000-hp motors. The mill stands are on 18-ft centers.

Power for the six driving motors is supplied by six 4000-kw ignitron rectifiers, each with its own transformer. The rectifiers are connected in pairs with each pair supplying two motors. Under normal operating conditions the three bus sections are at the same voltage, however the transformers are provided with taps so that the sections could operate at different voltages which may be as high as 750 volts or as low as 300 volts.

Figure 10 — Fairless 80-in. hot strip mill finishing train features high power.

Comparison between rectifiers and motor-generator sets have been made in many previous papers and need not be repeated here. Rectifiers were chosen because of their higher efficiency, lower maintenance, lighter foundations, and lower installed cost.

The majority of the hot strip mills now in operation are supplied from a common bus. In recent years, more consideration has been given to splitting the bus into sections. Sectionalized bus arrangements result in a decrease in the maximum short circuit currents and thus permit the application of circuit breakers with lower interrupting capacities. The sectionalized bus arrangement also widens the speed cone of the mill since some sections may operate at reduced voltage and permit the rolling of a wider range of schedules than that provided by the shunt field range of the individual motors.

Four possible bus arrangements were considered for the Fairless mill. A common bus arrangement was considered, but was rejected because of the possibility of having to interrupt exceedingly high short circuit currents, and also because of the lack of flexibility in the mill speed cone. A two-section bus could have been used as far as interrupting the maximum short circuit current, but was rejected because of the possible lack of flexibility in the mill speed cone.

An individual rectifier for each stand was also considered and this arrangement would have been satisfactory with the calculated mill loads and the calculated a-c line voltage drop. Such an arrangement would have reduced the magnitude of the possible short circuit current to a minimum, and would have provided the most flexible arrangement, as far as the mill speed cone was concerned. The individual rectifier scheme was not used because of the adverse effect on the bus voltage regulation which would be caused by future unpredictable a-c line voltage variations, or by arc backs.

The arrangement selected for the Fairless mill consists of a three-section bus and was chosen for the following reasons:

1. The possible short circuit currents are within the interrupting capacity of standard breakers.
2. The three bus sections and the motor shunt field ranges provide ample flexibility for any contemp'ated rolling schedules.
3. The arrangement, as compared to one with individual rectifiers, provides greater diversity and eases the problem of voltage regulation when arc backs or future, unpredictable, a-c line voltage drops occur.

The effects of a-c line voltage drops or arc backs on the three section bus arrangement as compared with their effects on an individual rectifier arrangement can best be illustrated by an example. Assume that in

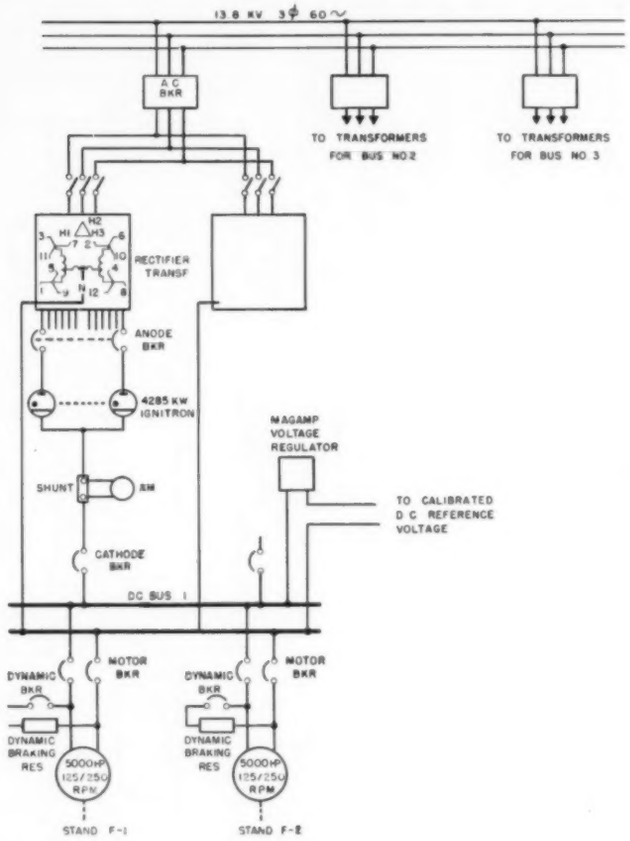


Figure 11 — Electrical arrangement for one bus section of the hot strip mill.

either arrangement the electrical equipment has been designed to maintain rated d-c bus voltage at 200 per cent load with a maximum drop in the a-c line voltage of 5 per cent, or to maintain the d-c voltage at 160 per cent load, with a maximum drop in the a-c line voltage of 7.5 per cent. Assume also that two adjacent stand driving motors of the same rating are operating at loads of 120 per cent and 200 per cent respectively.

When these two motors are connected to the same bus, the rectifiers supplying this bus would be at 160 per cent load, and the a-c line voltage drop could be as high as 7.5 per cent without effecting the d-c bus voltage regulation. Any increase in the a-c line voltage drop with an individual rectifier arrangement would result in a decrease in the d-c bus voltage, and a decrease in speed of the motor which was at 200 per cent load, thus creating rolling difficulties.

An arc back in one tube of a twelve tube, twelve phase rectifier assembly reduces the capacity of that

rectifier assembly by approximately 20 per cent. With the same, assumed loading conditions as described above, and with 95 per cent of normal a-c line voltage, an arc back would not effect the d-c bus voltage for the three section bus arrangement, however, with the individual rectifier arrangement, the d-c voltage of the more heavily loaded motor would drop approximately 5 per cent if an arc back occurred in its rectifier supply.

The above comparisons should not be interpreted to mean that individual rectifiers are not suitable for hot strip mill finishing trains. However, before using such an arrangement, careful consideration should be given to the maximum load on any one stand motor, the maximum a-c line voltage drop, and the expected arc back rate. If these factors are known or can be accurately predicted, and the electrical equipment chosen to be sufficiently oversize to compensate for the worst

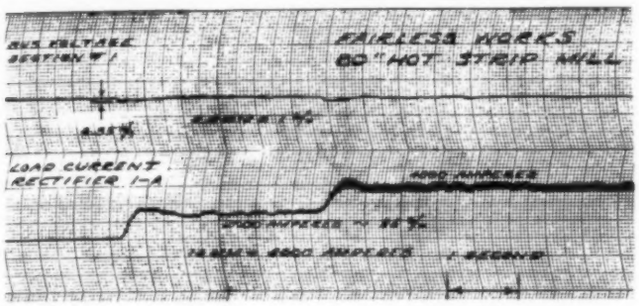


Figure 12 — Response characteristic of the voltage regulator.

conditions, then the individual rectifier arrangement would be satisfactory.

Figure 11 shows a schematic diagram of the electrical equipment for one bus section of the Fairless mill. A single a-c breaker connects the 13.8-kv power to the two rectifier transformers associated with each bus section. These transformers are for outdoor service and are oil-insulated, self-cooled. Their primaries are connected delta and their secondaries quadruple zig-zag. Each of the twelve-phase rectifier transformers are connected to each ignitron assembly by two, 6-pole, high speed anode circuit breakers. Semi-high speed breakers are used between the output of each rectifier assembly and the d-c bus. Two, single-pole breakers are used to connect each stand driving motor to the bus. Another single-pole breaker is used with each motor to apply dynamic braking.

Some of the hot strip mills which were supplied from a common bus have voltage variations of as much as 5 per cent. This has not been harmful since all motor speeds were affected in approximately the same proportion. However, when the bus is separated into sections, it is extremely important that the voltage of each section be carefully matched (or proportioned) in order to avoid any rolling difficulties.

The voltage regulating equipment must compensate not only for the IR drop due to the internal resistance of the rectifier but also for the drop in the a-c line caused by the rectifier load or other variable loads on the same a-c line.

The rectifier voltage is regulated by controlling the relative phase position of the ignitor current pulse which initiates the firing of each ignitron. A magnetic amplifier is used to regulate the d-c bus voltage of each section of the Fairless mill. The bus voltage is compared with a reference voltage and any differences between these voltages causes a current to flow in the control field of the magnetic amplifier. The output of the magnetic amplifier controls the phase position of the ignitor pulse, and in such a direction as to bring the bus voltage to the same value as the reference voltage. Figure 12 shows the response characteristic of the magnetic amplifier as the strip entered the first two finishing stands. For this particular rolling schedule, the voltage dropped approximately 0.35 per cent and recovered in about 0.15 seconds.

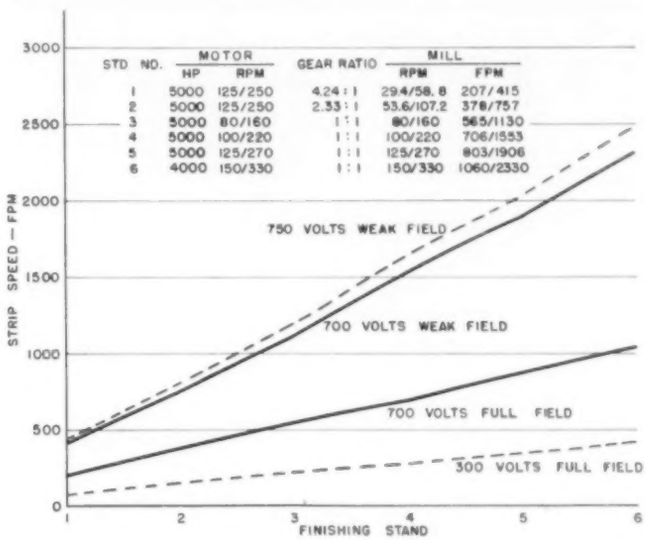


Figure 13 — Speed cone for the hot strip mill finishing train.

Figure 13 lists the motor ratings and gear ratios, and shows the speed cone when roll diameters of 27 in. are used in each stand. The solid lines show the normal speed cone with all motors at rated voltage. The dotted lines show the extension of the speed cone which could be obtained by changing the transformer taps. Since the mill was first started, all operation has been with the three bus sections at the same voltage, and such operation is expected to continue for any strip schedules. If the mill was required to roll plate, it is conceivable that the rolling schedule might necessitate operation with the bus sections at different voltages.

The rectifiers are normally started from control switches located on the duplex switchboard in the motor room. After the start-up, which requires only a few seconds, the mill is controlled from the operator's pulpit. The operator has a master control switch marked "Reverse-Off-Idle Run-Run," an idle run control switch marked "Fast-Hold-Slow," a job pushbutton and an emergency stop pushbutton.

When the master switch is in the "Reverse" or "Off" position, the ignitors are short circuited, the regulator control fields are open, and the master rheostat is in its minimum position. In the "Reverse" position the motor fields are reversed, and in the "Off" position, the motor fields are in the forward position. Depressing the "Jog" pushbutton, removes the ignitor short circuits, closes the regulator control fields and puts approximately 30 volts on the motor armatures.

When the master switch is in the "Idle Run" position, the idle run control switch can be used to set the bus voltage between 30 and 100 volts and is used when the mill is being levelled.

When the master switch is in the "Run" position, the bus voltage comes up to the maximum value as set by the particular transformer tap.

The mill has been in successful operation for approximately ten months and has been producing the products for which it was designed. The arc back rate has been exceptionally low and up to the present time the mill has never been delayed because of an arc back.

DISCUSSION

PRESENTED BY

W. E. MILLER, Manager, Steel Mill Engineering, Industrial Engineering Section, General Electric Co., Schenectady, N. Y.

C. H. LEGLER, Application Engineer, Power Dept., Motor Generator Section, Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

D. C. McCRADY, Superintendent Electrical Dept., The Steel Co. of Canada Ltd., Hamilton, Ontario, Canada

ERIC L. ANDERSON, Superintendent Electrical Dept., Bethlehem Steel Co., Johnstown, Pa.

WARREN REID and R. H. WRIGHT, Steel Mill Engineers, Metal Working Section, Westinghouse Electric Corp., East Pittsburgh, Pa.

W. E. Miller: I note that the paper states that the slabbing mill drive has been set up for reversal time of about 1½ seconds. That seems to be an optimum time in most cases. Certainly the state of the art of regulating systems is not a limiting feature. There have been reports of faster reversals. However, when you start trying to get reversals much shorter than that, it does begin to materially affect not only the cost of the excitation system but the machines have to be considered as well. In addition to that, if you are going to gain any additional production, you have to be sure that your auxiliary drives have adequate horsepower and the same high-powered excitation system in order to keep up with the mill.

One thing that comes up for discussion frequently these days is the method of load division between the main drives, that is the twin-drive motors. It is understood that the load division on this particular slabbing mill is to balance the load by differential adjustment of the voltage in the loop circuit. I think it would be of interest to know if the authors consider adjustment by generator voltage to be a better means of load division control than adjustment by motor field considering the effect of the method of control in the turnup or turndown of the front end of the slab.

I also note that the edger drive has a drooping characteristic to reduce the amount of power that might be transmitted between the two drives. I would assume that is by current limit control on voltage. I did not note a specific reference was made to that point.

Rectifiers are certainly becoming a well established source of d-c power for finishing mill drives. There are now four installations in operation in this country alone supplied entirely from mercury arc rectifiers. In addition, a number of hot strip finishing mills have rectifiers operating in parallel with motor-generator sets.

There also seems to be a trend, as the authors said, to split the hot strip mill bus into sections with the advantages of reduced short circuit stresses and increased flexibility in mill rolling schedules but with the disadvantage in diversity of rolling load.

However, from looking at the ratings of the particular drive motors and rectifiers described in the paper, it would appear that the diversity on the three bus sections is so slight that it would not affect in most cases the ratings of the rectifiers to go to an individual drive system. Actually, the finishing stands on one hot strip mill in the Pittsburgh area are supplied individually by generators. This installation was put in service a number of years ago.

Two more such mills are scheduled for operation during the coming year. In one new one the drive motors will be powered individually by six pumpless rectifiers. The other, which after revamping will end up with the most horsepower on a finishing mill, will be powered with individual power supplies for each stand with a generator operating in parallel with a rectifier. Four stands will utilize new pumpless rectifier substations and two stands will utilize existing rectifiers. Each rectifier will operate in parallel with one existing generator.

The individual drive system utilizing one rectifier or one generator per stand does simplify the breaker arrangement because again you get down to the one breaker per loop as shown in the paper for the sandwiched loop slabbing mill system.

Rectifiers are reliable, and modern methods of analysis and use of computers do permit very detailed design studies so that you can make system studies under arc back conditions and predetermine to a very considerable extent the reliability of the system. For instance, an analysis was made to determine the operation of the rectifier in parallel with the single generator. Also, the individual rectifier drive was designed so that should you have an arc back in one tube, you will not suffer a sufficient drop in voltage or get into loading conditions such that the drive will not continue to operate in the proper manner to continue the pass.

It would appear that wherever economically feasible, individual drive power supplies will continue to grow in popularity on blooming mills and hot strip mills as well as on cold strip mills. Also, the rectifier is certainly well established for non-reversing, infrequently accelerated and decelerated drives, and as the authors state, does offer advantages for such applications.

C. H. Legler: We had the privilege of furnishing the drives for the roughing train on this mill and I thought a few comments might be interesting here. The roughing train does not have anything radically new in the way of application as in the case of the finishing train. It followed more or less conventional lines except that the ratings were perhaps somewhat larger than had been applied on previous mills. Briefly, the scale breaker has a 2000-hp, 150-rpm synchronous motor. The

edgers have 500 hp, two of them, induction motors, 514 rpm. The universal mills each have 6000 hp, one at 240 rpm and three at 360 rpm, all synchronous.

Perhaps the most outstanding feature is in the physical size of the broadside mill drive which is a wound-rotor unit 3500 hp at 150 rpm. Because of the 13,800 volts and the low speed rating, it had to be made of a diameter which is probably as large as an induction motor has ever been built. The mill builder provided a fly-wheel which is about twenty feet in diameter which is mounted directly on the shaft and carried inside of the motor bearings.

This unit, because of its size, presented a little bit of a shipping problem. The shaft finally had to be shipped separate from the rotor and I remember that the corporation was very much concerned as to how they were going to get it to the site where it was to be used in one piece. They considered all kinds of methods of transporting the rotor unit assembled, even considering the possibility of shipping it by water down the Mississippi and around the Gulf and over to the east coast. That was finally ruled out and it was shipped in two pieces. The shaft was pressed into the rotor here in this area before final shipment into the Fairless plant. This same type of assembly job had been done previously at the Irvin Works some years ago where it was successfully done in the plant at the mill site. It was successfully done here at Fairless but outside of their plant because of different local circumstances.

D. C. McCrady: We have been interested in hearing about some of these very large installations down here. As a matter of fact we have been considering just recently the idea of changing over one of our reversing blooming mills to a scheme of that sort.

I was interested in knowing whether or not they found it necessary to use current limit control for the generator voltage from the standpoint of limiting current during acceleration and deceleration; apparently there are some who feel that the inherent time delay in the generator fields makes it unnecessary to deliberately build in a current limit scheme.

Member: On the current limit on the generator, what happens in the case of an overdraft where your feed is 250 per cent? Can you change the load just by bringing it down to zero speed?

Eric L. Anderson: One point of interest to me is, that in the application of rectifiers the voltage range on the bus is said to be adjustable from 300 to 700 volts. It is my understanding that to secure this type voltage range by phase control on the rectifiers will present a problem of low power factor, especially at the low voltage. I would be interested in knowing how this adjustment of voltage on the rectifiers is made, whether by phase control, by load ratio control or by tap changers on the transformer which would necessitate the shutting down of the mill in order to change voltage values. How many taps would be provided between the 300 and 700 volt range? What percentage of voltage could be provided with straight phase control and a reasonably good power factor still be retained?

Warren Reid and R. H. Wright: Mr. Miller has raised the question as to whether generator voltage control is a better method of load division control than motor field control, considering the effect of controlling the turnup or turndown of the front end of the slab. Slab thickness, the elevation of the pass line above the tables, and possibly the roll contour can affect the tendency of the slab to curl up or down. Unbalancing the forces at the roll periphery by electrical means has not been too successful in controlling the slot curvature, regardless of whether the unbalance was accomplished by generator voltage or motor field control. It should be noted that any appreciable unbalance can seriously reduce the mills capacity. Load division on the Fairless mill is accomplished by voltage control because it is faster and less complicated. Theoretically it is correct only when the top and bottom rolls are of the same diameter. If the rolls are of a different diameter then the force at the roll periphery of the smaller roll would be greater. The difference is not considered serious, since the variation in roll diameters is rather small. In a slabbing mill, the elevation of the pass line above the tables can usually be adjusted to counteract the tendency of the slabs to turn up or down. For other applications it is sometimes desirable to operate on the motor fields.

In answer to Mr. Miller's comments concerning the edger drive, the drooping characteristic is obtained by a combination of voltage and field control.

Mr. McCrady and another member have questioned the effect of the generator current limit control. When the mill is being accelerated and the motor current exceeds about 175 per cent of the full load value, the motor current regulator will act through the motor field regulator to increase the field current, thus decreasing the speed, increasing the motor torque, and decreasing the motor current. If the overload occurs before the motor is above base speed, the action of the current limit regulator on the motor field is relatively ineffective because of motor field saturation, and the motor armature current could not be reduced materially. When the motor load reaches about 200 per cent, the action of the current limit field of the generator voltage regulator reduces the generator voltage or the rate of rise of the generator voltage. The generator current regulator thus decreases the rate of mill acceleration and reduces the accelerating current. In case of an instantaneous overload, the generator current regulator is of no value and protection is provided by overload relays to remove generator excitation (usually set at about 250-260 per cent load) or by the main circuit breakers which have a maximum setting of about 275 per cent load.

In answer to Mr. Anderson's questions, no load tap changers are provided on the primary of each transformer to give maximum d-c bus voltages of 700, 650, 530, 430 and 300 volts at 200 per cent load. The mill must be shut down to change taps. Tap changers under load are available, however, the infrequent need to change tap at Fairless did not warrant their additional cost.

Each of the taps mentioned above result in a power factor of approximately 94 per cent. The maximum d-c voltage corresponding to each tap can be reduced by 15 per cent by phase control and each one per cent reduction in voltage corresponds to about a one per cent reduction in power factor.

CURRENT AISE DISTRICT SECTION MEETING NOTICES

BIRMINGHAM SECTION

Monday, February 28, 1955 — Social Hour 6:30 P.M., Dinner 7:00 P.M., Meeting 8:00 P.M.

"The Manufacture of Cast Iron Pressure Pipe by Centrifugal Process," with Movie by Herbert W. Stuart, Director of Quality Control, United States Pipe and Foundry Co., Birmingham, Ala.

Thomas Jefferson Hotel, Birmingham, Ala.

BUFFALO SECTION

Tuesday, February 8, 1955 — Dinner 6:30 P.M., Meeting 8:00 P.M.

"Electrical Driven Billet Flying Shear — U. S. Steel Fairless Works," by W. H. Wiggenton, Electrical Engineer, Morgan Construction Co., Worcester, Mass.

Hotel Sheraton, 715 Delaware Avenue, Buffalo, N. Y.

CHICAGO SECTION

Tuesday, February 1, 1955 — Dinner 6:15 P.M., Meeting 7:45 P.M.

"Induction Heating as Applied to Continuous Processing Lines," by E. H. Browning, Manager, Metal Working Section, Westinghouse Electric Corp., East Pittsburgh, Pa.

Phil Smidt's Restaurant, 1205 N. Calumet Avenue, Hammond, Ind.

CLEVELAND SECTION

Tuesday, February 15, 1955 — Dinner 6:30 P.M., Meeting 8:00 P.M.

"Application of Television in Industry," by Willis McCord, Director of Electronics Div., Diamond Power Specialties Corp., Lancaster, Ohio.

University Club, 3813 Euclid Avenue, Cleveland, Ohio.

DETROIT SECTION

Tuesday, February 15, 1955 — Dinner 6:30 P.M., Meeting 8:00 P.M.

Detroit Edison Night —

"Development and Applications of Gas Turbines to the Steel Industry," by D. R. Jenkins, Manager, Gas Turbine Section, Westinghouse Electric Corp., Philadelphia, Pa.

Dinner — Cafeteria, General Office Building. Meeting — Sales Auditorium, Service Building.

Inspection Trip through "Emergency Control Center."

LOS ANGELES SECTION

Monday, February 14, 1955 — Dinner 7:00 P.M., Meeting 8 P.M.

"Future Energy Sources," by E. W. Morris, Manager of Engineering and Service Div., Southern Pacific District, Westinghouse Electric Corp., Los Angeles, Calif.

Turf Club, Rivera, Calif.

PHILADELPHIA SECTION

Saturday, February 5, 1955 — Dinner 6:00 P.M., Meeting 7:00 P.M.

"Modernization of the Blooming and Slabbing Mills at Sparrows Point"

"Engineering and Mechanical Features," by P. E. Apple, Squad Foreman, Engineering Dept. and Marvin Whitmore, Assistant Master Mechanic, Rolling Mills, Bethlehem Steel Co., Sparrows Point, Md.

"Electrical Features," by H. W. Dorset, Assistant Superintendent, Electrical Dept., Bethlehem Steel Co., Sparrows Point, Md.

"Soaking Pit Improvements," by H. C. Henschen, Combustion Engineer, Bethlehem Steel Co., Sparrows Point, Md.

Engineers' Club, 1317 Spruce St., Philadelphia, Pa.

PITTSBURGH SECTION

Monday, February 14, 1955 — Social Hour 6:00 P.M., Dinner 7:00 P.M., Meeting 8:00 P.M.

"Pre-Attack Planning for Industrial Defense," by W. R. Ramsay, Industrial Defense Coordinator, Jones and Laughlin Steel Corp., Pittsburgh, Pa.

Gateway Plaza, Gateway Building 2, Pittsburgh, Pa.

ST. LOUIS SECTION

Wednesday, February 23, 1955 — Dinner 6:30 P.M., Meeting 7:30 P.M.

"Cranes and Crane Maintenance," by G. T. Raubach, Service Div., Harnischfeger Corp., Milwaukee, Wis.

Rose Bowl, Granite City, Ill.

SAN FRANCISCO SECTION

Tuesday, February 1, 1955 — Social Hour 6:00 P.M., Dinner 7:00 P.M., Meeting 8:00 P.M.

"Science vs Crime," by William Whelan, Special Agent in Charge, Federal Bureau of Investigation, San Francisco, Calif.

Villa De La Paix Restaurant, 116 Sixth Street, Oakland, Calif.

YOUNGSTOWN SECTION

Monday, February 28, 1955 — Social Hour 6:00 P.M., Dinner 7:00 P.M., Meeting 8:00 P.M.

"The Manufacture, Testing and Use of Plastic Pipe," by Dr. Karl L. Fetters, Assistant to the Vice President in Charge of Operations, Youngstown Sheet and Tube Co., Youngstown, Ohio.

Mahoning Country Club, Girard, Ohio.

DEVELOPMENTS

in the

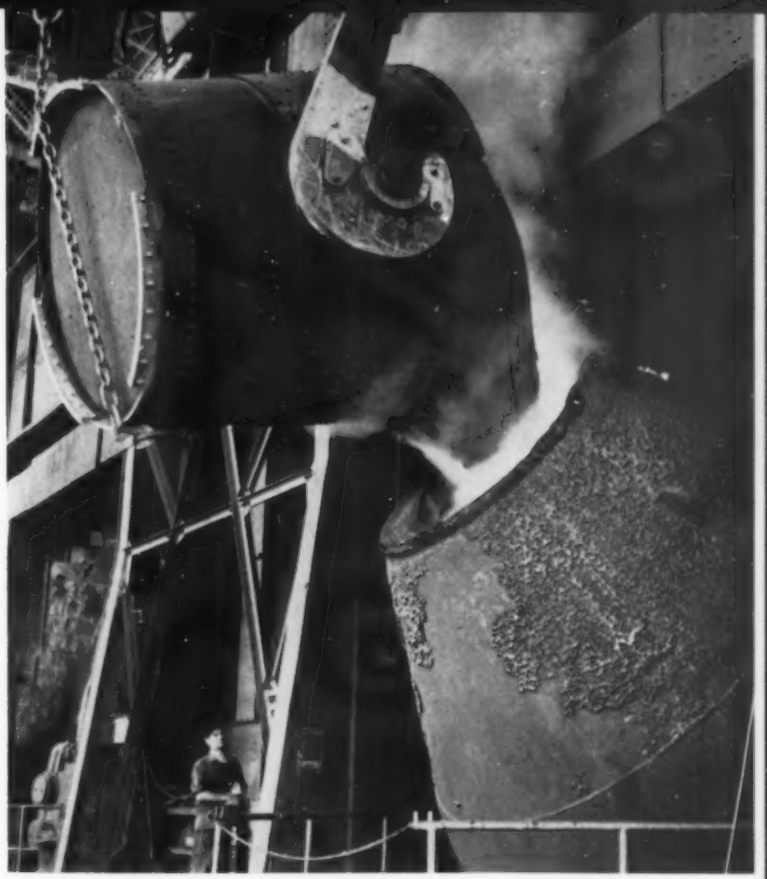
IRON AND STEEL INDUSTRY

during 1954

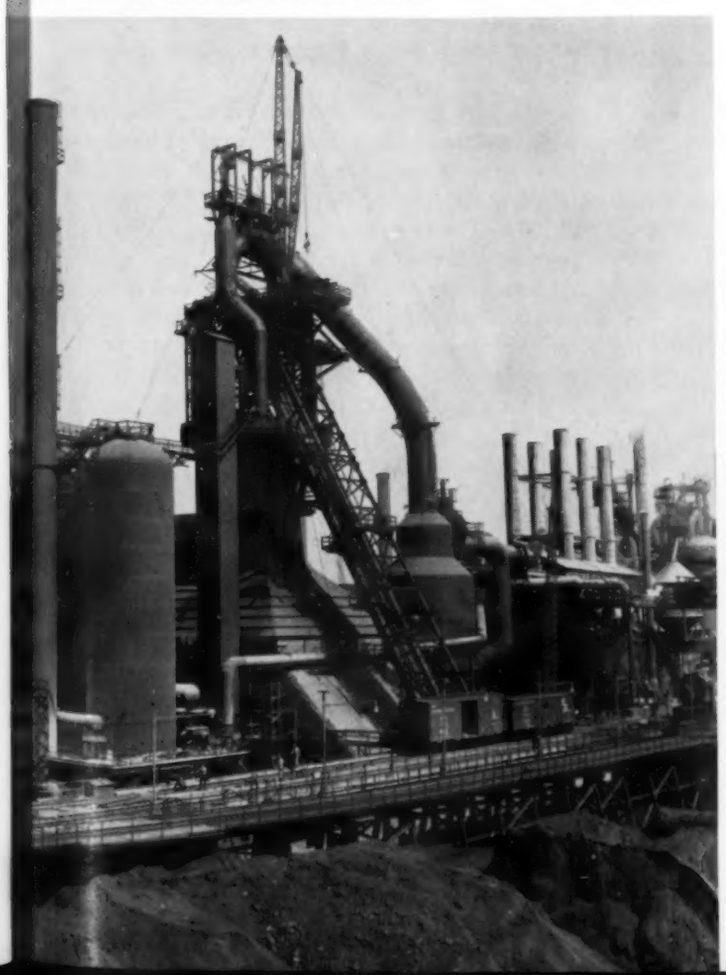
By

I. E. MADSEN

▲ COMPETITION, real competition, returned to the steel industry in 1954. The problems and effort on the part of the steelmaker shifted from that of production to that of sales. The reduction in production and operating rate, particularly through the summer months, made sales the key to profits. The huge capital investments required to make steel, particularly the investments which have been needed to increase capacity since World War II, make it essential that the steel industry operate at rates which will utilize most of its equipment. Even though the new equipment is more efficient, fixed costs of such equipment may be four to five times that of the original facilities.



Oxygen blowing is expected to revive the bessemer converter.



New blast furnace "A" of the American Steel and Wire Div. of United States Steel Corp. will be used primarily for making merchant iron.

That much talked-of term "the break even point" which had been estimated at many widely varying figures seemed to settle down somewhere between 70 to 75 per cent. This point, of course, varies from company to company, and with the product mix. However, financial reports from various companies while operating at these rates often showed losses when the rate was below this figure, and when rates were above this figure they kept out of the red. This break even point is appreciably lower than has been estimated in the past few years, although much higher than the 35 to 50 per cent of capacity at which several companies managed to break even before World War II. The break even point was affected by the elimination of the excess profits tax and perhaps even more by efforts to cut costs and eliminate some of the fat which had gradually crept into operations in the drive to keep production at peak and over-capacity rates.

The reduction from peak operations affected the operator in a number of ways. Maintenance was easier, and it was possible to do jobs which had been postponed for a long time. Emphasis was on using more efficient facilities, and some of the more obsolete units went out of production.

Even though demand was down, intensive work on the part of the steelplant engineer went on to design

and construct additional facilities, usually for the finishing end, aimed at product for which demand was the greatest. An example of this program was the emphasis on additional facilities for producing tinplate and for galvanizing. It was felt that such facilities would help to keep ingot rates at higher levels and keep more employees at work. There was no appreciable construction on additional steelmaking capacity, except for those units previously authorized and now being completed, and a few minor cases where a better balanced plant was sought.

Steel production in 1954 in the United States was estimated at 88,305,579 tons, or 71 per cent of 1954 capacity. This is equivalent to an index of production of about 105.4 per cent. Of this, open hearth production totaled about 80,327,290 tons, or 73.6 per cent capacity, bessemer production totaled 2,547,978 tons, or 53.2 per cent capacity, and electric furnace production totaled 5,430,311 tons, or 52.0 per cent of capacity. Of the total steel produced, open hearth took 90.9 per cent as its share, bessemer, 2.9 per cent, and electric, 6.2 per cent.

These figures compare with total production of 111,609,719 tons in 1953 or 94.9 per cent of capacity, of which open hearth steel was 100,473,823 tons or 97.9 per cent of capacity, bessemer was 3,855,705 tons or 83.2 per cent of capacity, and electric furnace was 7,280,191 tons or 71.1 per cent of capacity. Of this, in 1953 the open hearth share was 90.0 per cent, bessemer 3.5 per cent and electric furnace was 6.5 per cent.

It can thus be seen that in 1954, open hearth steelmaking held its own or gained slightly whereas the percentage share of bessemer production dropped and that of electric furnace steel also dropped slightly more than its share.

Blast furnace production in 1954 totaled about 58,350,000 tons. This is about 71 per cent of capacity, based on an annual capacity of 82,001,390 tons in 1954. This compares with production in 1953 of 75,856,872 tons. Estimated in the 1954 figure are about 560,000 tons of ferromanganese and spiegeleisen. Coke production in 1954 totaled about 61,000,000 tons compared with 78,836,857 tons in 1953.

Finished steel production in 1954 was about 64,000,000 tons compared with 80,151,893 tons in 1953.

Steel tonnage in 1954 represents a level of production which, though down from the previous year, has been exceeded only once in a peace-time year; in 1948 when steel production was 88,600,000 tons. There have been six other years with larger tonnages, ranging from 88,800,000 in 1943 to 111,600,000 in 1953, but these years were wholly or partially under the influence of war-time demand.

It is believed that about 7,800,000 tons of finished steel were used from inventory during 1954, particularly in such industries as the railroads, which would indicate that about 71,000,000 tons of finished steel were used in 1954. In only 1950, 1951 and 1953 has this usage been exceeded. If steel in inventory had not been used, ingot production would have been about 10,500,000 tons higher.

Predictions for steel production in 1955 vary between 75 and 85 per cent capacity, or 95,000,000 to 106,000,000 tons of ingots.

At the end of the year, preliminary statistics indicated that American industries spent about $27,000,000,000 on new plants and equipment in 1954. Surveys indicate that the amount to be spent in 1955 will be only slightly less.

Intensive work is under way on the development of taconite ores. Scene shows an aerial view of the Babbitt plant.

Steel business picked up appreciably at the end of the year, when the operating rate went up around the 80 per cent mark. This pickup was primarily due to the reentrance of the automobile manufacturers into the steel market. The automobile industry appeared optimistic and was predicting an output of well over 5,000,000 cars in 1955, which should keep this segment of business good next year. Automobile production in 1954 was about 5,500,000 cars and 1,000,000 trucks compared with 6,200,000 and 1,200,000 respectively in 1953.

One of the factors in the 1954 operations was the reduction in the amount of direct military shipments which probably amounted to no more than 1,000,000 tons in 1954 compared with almost 3,000,000 tons in 1953. Construction, a big prop for steel, zoomed at record rates throughout the year, giving strong demand to structurals, concrete reinforcing bars, etc. The oil industry's demand for pipe was also a help. Outside of construction, containers had probably the most important increase over 1953. Here a good selling job against the competition of glass, wood and plastics resulted in the usage of around 7,000,000 tons of steel.

Some trends during 1954, which might be considered a year of peacetime normalcy, indicate that the future will bring increased steel demand for containers, highway and bridge construction, office buildings, industrial buildings and homes. The demand for these products is largely due to increased population. It has been estimated that these programs will stimulate ingot demands to a level of about 108,000,000 tons in order to ship 75,000,000 to 80,000,000 tons of finished products.

Inherent in this demand are shifts in product mix due to greater demand for electrolytic tin plate with less usage of hot dipped product, greater emphasis on wide flange rather than standard structural shapes.

That the steel industry is anticipating such trends is indicated in the expansion programs which emphasize tin plate facilities and additional wide flange structural capacity.

Factors in future demand for tin plate are the additional products for which tin plate is being considered as a packaging material. Soft drink in cans has definitely arrived. About 10,000 tons of tin plate were used in soft drink cans in 1953 and this increased to 75,000 tons in 1954. This will be doubled in 1955. If one-half of the present soft drink bottles were replaced by cans, they would represent a market of 1,000,000 tons of tin plate.

Work is also under way on tinplate for milk containers. If this works out, the demand will be tremendous. Tin-plate packaging could keep milk fresh over long periods of time so that the frequent trips to the store or visits of the milk man will be unnecessary. This will result in lower distribution costs.

Another application for tin plate tried during the year is the shipment of wine in cans. A previous problem when tried some time ago, metallic taste, has been overcome in new cans by a wax lining which is sprayed on the can after it is made.

One steel company estimates that sales of stainless and silicon steel should double about every ten years. In 1953 stainless shipments were 602,000 net tons and ten years earlier they were 269,000 tons. Silicon shipments in 1953 were 820,000 tons and in 1946 were only 306,000 tons.

Since most of the major natural gas lines will soon be completed, it is expected that demand for large diameter line pipe will drop.

As an indication of the future, planning departments of most major steel companies are busy with plans for future expansion. Estimates by steel company managements indicate that capacity must increase at least another 20,000,000 tons in the next 10 years, putting ingot capacity in the 140,000,000 to 150,000,000-ton bracket. To eliminate a substantial amount of present capacity which is considered obsolete or inefficient and which must be retired in this period, another 10,000,000 tons of capacity will be required. This means a lot of construction.

Although capacity will be increased, it does not necessarily follow that the number of units will increase, as the trend continues toward larger and more efficient blast furnaces, coke plants and open hearths. Actually, the total number of some of these units in operation today is less than it was years ago.

One big factor in the accomplishment of this necessary expansion in the steel industry will be the availability of investment capital. At the Iron and Steel Institute annual meeting last spring, E. T. Weir, chairman of National Steel Corp., estimated that, in addition to money required for additional expansion, today's capacity of 124,000,000 tons will have to be replaced completely within the next thirty years, requiring a minimum investment of $30,000,000,000 or an average of $1,000,000,000 a year. Such money will not be made available unless the investing public feels that its return will be adequate and secure. Some of this capital will come from earnings, but much must come from capital investment, and one of the problems of the steel industry is to make operations profitable enough to attract this capital. If this is not done, defense considerations may require the entrance of the Federal government into the steel business.

Steel companies have spent $6,000,000,000 for modernization and expansion of steel plants since the end of World War II. The iron and steel industry invested approximately $775,000,000 in 1954 for expansion and improvement of their plants, according to the American Iron and Steel Institute. This was somewhat under the $1,000,000,000 spent in 1953.

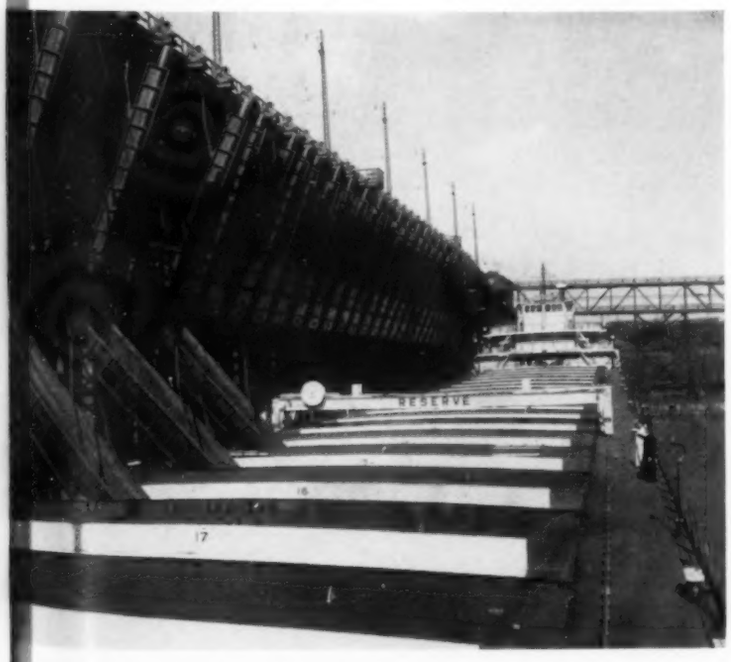
Steel capacity at the end of the year was 125,838,310 tons, up 1,497,900 tons since Jan. 1, 1954. This jump was primarily due to better efficiency, and enlargement of existing units rather than additional facilities. Blast furnace capacity increased 1,969,710 tons to a new figure of 83,971,000 tons on January 1, 1955. Coke plant capacity increased to 72,684,750 tons, from 71,181,190 tons. This last figure applies only to coke capacity of iron and steel producers. Total U. S. coke capacity is now about 90,000,000 tons.

At the present time the steel industry in the United States consists of 255 companies which have 430 plants making or finishing iron and steel in 270 communities in 31 states. These figures do not include raw material properties or other facilities not directly involved in steel production.

A factor in the location of future steel plants has been the information made available on the effect of the H-bomb, and the ODM is studying incentives to increase decentralization. As an example of what may happen, the dropping of a single bomb in Pittsburgh would damage plants up to a thirty mile radius or perhaps partially knock out or damage 25 per cent of this nation's steel capacity.

Fortunately there was little labor trouble in the steel industry in 1954, and negotiations with the steelworkers unions were carried out without a strike. An agreement was signed on June 29 which gave a flat 5¢ an hour

A cargo load of taconite ore initiated the ore season last spring.



wage increase, improved insurance program, and additional benefits in the pension program.

A new development in the labor field is the attempt to merge the A.F. of L. and the C.I.O. Two three-man committees are drafting a constitution for such a merger, which these groups hope will come up for a vote by their respective federations before the end of 1955. Such merger may make the groups more difficult to deal with.

The average hourly payroll cost of wage earners in the steel industry in the third quarter of 1954 reached a new high level of about $2.36 which was an increase of about 6 cents an hour over the average for the first half of the year. This was a result of the increases in wage rates which became generally effective on July 1. If the estimated cost of pensions, social security and insurance are included, average hourly employment cost in the third quarter was about $2.53. The 1954 payroll in wages and salaries was about $2,850,000,000. to about 600,000 people.

The post war expansion in the steel industry capacity has been instrumental in providing facilities for the employment of at least 100,000 more people than those employed in January, 1946.

After the signing of the contract with the steel workers in mid-1954, price increases were announced which averaged $3.00 per ton of steel products. This increase probably did not reflect the increased cost, which is typical of the trend, since steel wages have jumped 101 per cent since 1945, and the prices have climbed on the average only 84 per cent. One composite price of finished steel at the end of the year was about $118, which is up about 4 per cent from a year ago.

The approval of the United States Congress in 1954 of the Saint Lawrence Seaway project will have far-reaching effects on the long term plans and location of the steel industry. With completion of this waterway, oceangoing vessels can sail direct to the lake ports, making ore from Quebec or Venezuela accessible and economical for inland plants. In addition, this waterway will open up waterborne shipments of steel products from the lake ports. The presence of this waterway may well reverse the trend of the steel industry to the east.

The Seaway also has obvious advantages from a defense standpoint as it will provide protected transportation to the steel plants.

Another waterway program of interest to the steel industry was authorized by Congress in a bill providing for deepening the 25-ft channel in the Delaware River north of Philadelphia to Trenton, N. J., to 40 feet. Although the bill authorized the work, no action was taken on an appropriation for the project, which is estimated to cost about $91,000,000.

Another development in transportation approved by the Interstate Commerce Commission is the so-called door-to-door, piggy-back service. Rules were set up governing transportation of highway trailers on rail flat cars. A number of the railroads immediately started this operation, and both shippers and railroads are enthusiastic.

Effective March 26, 1954, the ICC granted east and central railroads a temporary cut in freight rates for some steel products, amounting to about 15 per cent. This cut expires December 31, 1955. The new rate was effective in increasing the amount of steel products shipped by rail, at the expense of the truckers, and also gave resultant economies to the steel buyer. However, it was questionable whether it helped the railroads' income, as a rather substantial boost in business was needed to offset the lower rates.

The 15 per cent rate freight reduction involves appreciable savings as it is estimated that the steel industry spends about $17,000,000,000 annually on transportation. On the other hand, the decline of business, particularly in the middle of the year, resulted in some freight absorption which may have cost the steel producers from $50,000,000 to $70,000,000 for the year.

There is agitation in Congress on delivered price legislation. The court decision which approved good faith competitive pricing is meeting opposition from a group led by Senator Kefauver, who is trying to introduce legislation which will eliminate the practice.

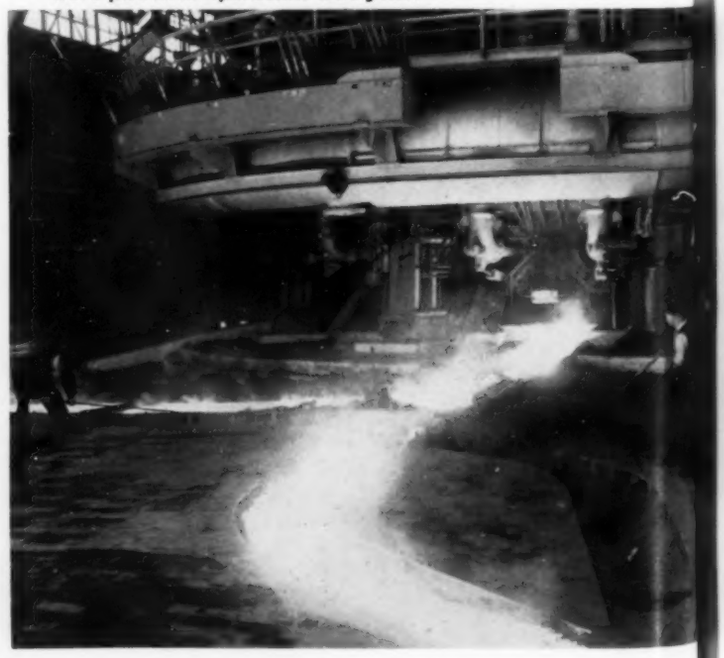
To oppose this, another bill which would legalize the practice, has been introduced by Senator Capehart. This bill would put on the legislative books the spirit of the decision made by the Supreme Court.

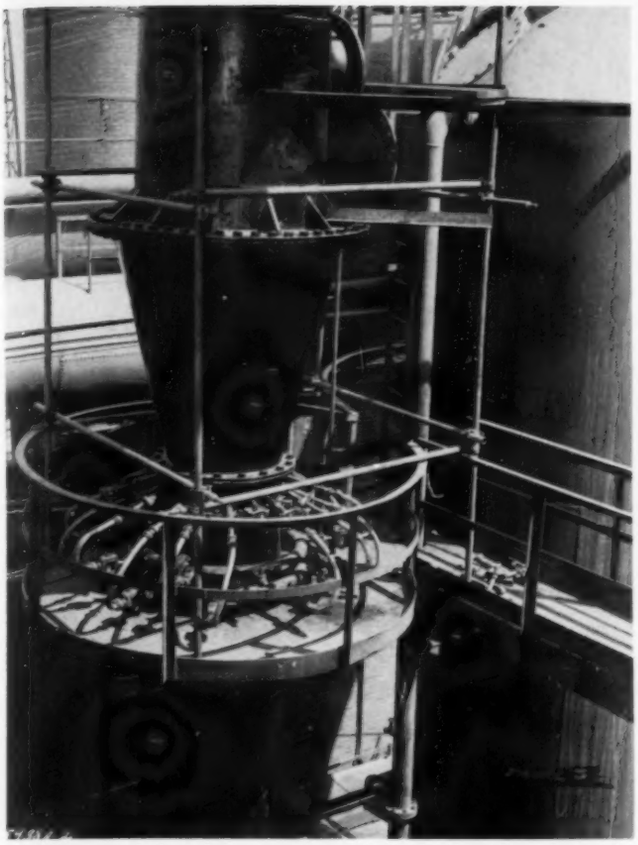
An item of importance to the steel industry is the tax revision bill which was adopted last year. A depreciation provision in this bill was used by a number of the companies for their financial statements this year. Under this, companies are allowed to write off 67 per cent of the value of their equipment in the first half of the estimated life of the new plant or equipment. This bill may result in additional installations of new equipment.

The importance of maintenance and the magnitude of the job was brought out during the year at a maintenance meeting where it was pointed out that yearly maintenance cost to all industry, now $11,000,000,000, will increase to about $22,000,000,000 by 1964. Factors in this increase are the expansion of industrial capacity and the more complicated and elaborate equipment in use.

Fire protection and fire losses are becoming a more

The Queen Anne (here shown) and the Queen Victoria are the largest blast furnaces in England today. Both were put into operation this year.





In the venturi washer for blast furnace gas, the washer is injected at the throat through 18 nozzles.

important factor. Losses in the period 1942 to 1953 in U. S. metals plants totaled about $150,000,000 compared with $8,500,000 between 1931 and 1942. This covers fire losses only where the damage was more than $250,000. Flamable liquid fires have been the predominant evil. Most of the losses were in plants without sprinkler systems. Damage was large in many cases because of lack of water supplies and poor fire fighting units.

A great deal of furor was raised during the year when officials of Bethlehem Steel Corp. and Youngstown Sheet and Tube Co. announced that they were considering merger of these two companies. These plans show how much cheaper it is to buy another company now than to build a new unit. At the prevalent stock prices, for Y.S.& T., the market value of the stock is about $245,000,000. Since the company has an ingot capacity of 5,500,000 tons, construction of such a unit at $300 a ton would require over $1,650,000,000 or seven times more than if bought in the form of stock. The Justice Dept. has indicated that they would not approve the merger.

Another example of the problems which can occur when a company wishes to sell out are those which beset Follansbee Steel Corp. which agreed to sell its physical plant to the Richmond interests. Even though a large majority of the stockholders were in favor of the sale, a small minority group was able to get a temporary court order preventing the sale. An active influence was local opposition in the town, which feared loss of jobs if the physical equipment were sold to Republic Steel and moved to Gadsden as preliminary plans indicated would be done.

Late in the year when the proposed sale was blocked by a court order, Republic Steel Corp. released F. W. Richmond from his agreement to them. On December 23, Mr. Richmond bought all Follansbee assets for $9,286,620. He sold the Federal Enameling and Stamping Div. for about $3,400,000. This was purchased by Charles Wiener of Chicago and Myron Hokan of Detroit. He sold the mill and specialty division in Follansbee, W. Va. to Cyrus Eaton of Cleveland for about $2,400,000, and Mr. Eaton is believed to have agreed to operate the plant at Follansbee for at least three years.

DETAILED EXPANSION

Although a number of new expansions were announced during the year, the attention of the steel industry during 1954 was directed principally towards pushing existing programs and digesting what had been already accomplished. Additional programs were generally directed at finishing facilities for products in strong demand and at installations for replacing obsolete or uneconomical equipment.

United States Steel Corp. made several announcements. One of the larger items on their program is a $10,000,000 project for improvements in finishing facilities for structural shapes at the Homestead Works. This will add facilities for the production of light wide flange shapes which are taking an ever increasing percentage of the market. Similar improvements are planned for the structural mill at the South Works in Chicago.

The United States Steel Corp., also announced a large expansion for their steel pipe plant at Geneva Works of Columbia-Geneva steel division.

Still another project of U. S. Steel is the rehabilitation of their No. 2 rail mill at Edgar Thomson Works. In this program are new furnaces in which high thermal release burners will be used for heat treatment of rail ends. Roll stands will also be relocated for more efficient production of current rail lengths.

An extensive program is underway at U. S. Steel's Vandergrift Works for the production of silicon steel. Included in this program are a hot strip mill, furnaces and cold finishing facilities. This equipment will replace the old sheet mills.

The National Tube Division of U. S. Steel announced that it will install a new battery of coke ovens at Lorain Works. This battery, the fifth installed since the plant was modernized in 1947, will consist of 59 gun flue type ovens. The ovens will go into operation in the fall of 1955 and will carbonize about 1100 tons of coal per day. Another similar 59-oven battery was essentially complete at the end of 1954.

American Steel and Wire pushed coke on a new battery in Cleveland on December 24, marking completion of a five-year rebuilding program at this plant. Dismantling of this battery started last January. The new unit is similar to the other three batteries at the plant and will produce 600 tons of coke daily.

The open hearth furnaces at the Worcester plant were closed down in 1954. Ingots are now being supplied from the Fairless Works.

During 1954 Bethlehem Steel spent $20,000,000 to $25,000,000 on five substantial projects. About $5,500,000 was spent at Sparrows Point plant for provision of additional fresh water, raising the capacity from

60,000,000 to 150,000,000 gal per day. A second program involves expenditure of about $5,000,000 for a new continuous galvanizing line at Sparrows Point. A third program will result in a completely new steel fabricating plant in the Los Angeles, Calif., area, retiring the existing plant. A new battery of coke ovens are planned for Steelton, Pa., as well as a new rod mill for Johnstown.

As a result of demand from the building and construction industry, work on enlarging structural capacity, particularly for wide flange beams is being done by the major structural producers. Bethlehem Steel is increasing its capacity at Bethlehem by 50 per cent or up to 210,000 tons per month. The Bethlehem program at the Saucon plant includes a shipping and storage yard, four new soaking pits, a 32-in. blooming mill to feed the existing 12, 18 and 28-in. mills, modernization of the 40-in. blooming mill, extensions to the hot beds of the 42 and 48-in. wide flange mills, and two new heating furnaces for the 28-in. mill.

Republic Steel Corp. announced plans for a $10,000,000 expansion and improvement program which includes $5,000,000 for a continuous hot dip galvanizing line in Warren and a hydraulic pipe expander for electric weld line pipe at Youngstown. New hot strip coiling equipment will be installed at the Cleveland district. The hot dip galvanizing line will increase finishing facilities at Warren by about 9000 tons a month, and will handle cold rolled steel up to 48 in. wide, in coils up to 40,000 lb in weight, with a maximum thickness of 16 gage, at rates of about 300 fpm. Coils will be annealed and temper rolled before entering the galvanizing line.

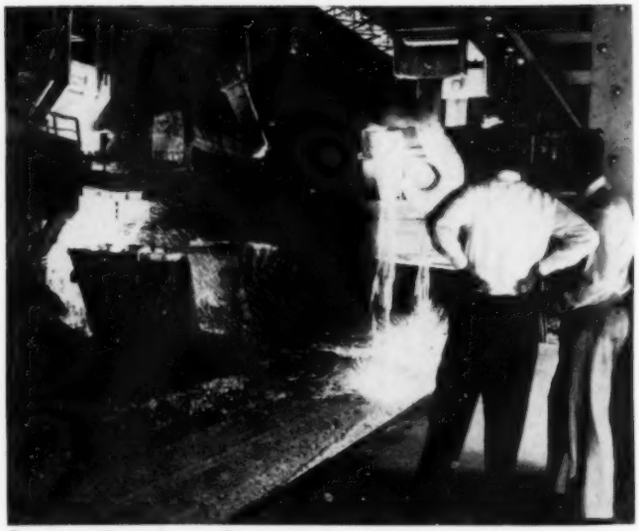
Republic Steel also announced that it is increasing its seamless tube capacity at South Chicago by about 70 per cent with the addition of new facilities for rolling small size tubing. Completion is scheduled for the spring of 1955, and mill capacity will be increased from 186,000 to 312,000 tons a year. Equipment to be installed includes a billet heating furnace, piercing mill, plug mill and two reelers.

Republic was also planning to diversify its Gadsden, Ala., plant and move equipment to that plant from Follansbee Steel Corp. which it was to purchase from the Richmond interests. Included in the transaction were cold strip reduction mills and auxiliary finishing equipment. Although at the end of the year the Richmond deal fell through, Republic indicated it would still go ahead with this program.

Jones and Laughlin Steel Corp. announced that they plan to spend $51,000,000 on an additional improvement program in 1955. Included are equipment for producing new joist sections in the 14-in. bar mill at Aliquippa, additional facilities for production of high strength and special seamless tube for the oil industry, an electric weld pipe mill, and additional wire and wire specialty manufacturing facilities at Aliquippa, and a continuous sheet galvanizing line at Pittsburgh. This line will take product up to about 48 in. wide in gages from 14 to 30, and will have a capacity of about 7000 to 8000 tons a month.

The new cold sheet mill at Indiana Harbor, the last major unit in Youngstown Sheet and Tube Co.'s expansion program, was completed in the first quarter.

The first coke was pushed on August 12 from a new 76-oven by-product battery at the Campbell Works of



Granite City Steel Co. completed its expansion program this year. Steel is shown being tapped from one of the new 285-ton open hearth units.

Youngstown Sheet and Tube Co. at Youngstown, Ohio. This battery will have an annual capacity of about 450,000 tons a year. Construction was started during the summer on a similar battery to be completed in the summer of 1955.

Inland Steel Co. announced that it will install facilities to produce wide flange structural beams at the Indiana Harbor plant. In this program Inland will revamp its 28-in. mill, on which standard structural shapes and rail are now being rolled, so as to accommodate wide flange beams in addition to present products. Work will be completed sometime in 1955, and the mill will have a capacity of 325,000 tons of 8 to 24-in. wide flange beams annually.

Inland Steel also announced plans for a third continuous galvanizing line at Indiana Harbor. Construction will be completed by the end of 1955. The line will have a capacity of 80,000 tons annually.

During the year Inland expanded their ingot capacity from 4,700,000 to 5,000,000 tons. The increase came without additional physical facilities but through boosting production from existing facilities.

In addition to the items previously described, Inland has an extensive program in developing their Caland ore properties in Ontario, Canada. Other items on the program are additions to power generating capacity at the Indiana Harbor Works, construction of six new soaking pits, and improvements in the cold rolled sheet and tin plate departments.

Part of Weirton Steel Corp.'s expansion program is a five-stand, four-high cold reduction mill for tinplate, scheduled for completion in 1955. This unit is expected to have a maximum speed of about 7000 fpm and will produce strip up to 48 in. wide.

Weirton also put into operation a new coke battery in February, consisting of 41 underjet ovens designed to hold a 17-ton coal charge. The battery will produce 700 tons of furnace coke daily.

Armco Steel completed their current $10,000,000 expansion program at the Ashland Works during the year. Supplementing the $40,000,000 hot strip mill completed in 1953, the new facilities include a 4-high, 58-in. cold reversing mill, a continuous strip pickler and two continuous galvanizing lines. One of these is for heavy

gages and the other for light gages. The first line can handle materials up to 80 in. wide, the second up to 50 in.

Armco also started construction on a new water supply project which will clarify cooling water for their East Works at Middletown. The new system will save more than 10,000,000 gallons of water per day.

Armco is installing a new bar mill at Baltimore, designed to roll stainless steel in a wide variety of sizes and grades. It should be completed by the end of 1955. Estimated cost is $5,500,000.

Armco also started an expansion of their fabricating division at Middletown for fabrication of steel products.

Wheeling Steel completed additional annealing facilities in their cold strip department at Steubenville, giving them capacity to anneal all steel processed in Steubenville. Wheeling also announced it would construct a second continuous galvanizing line.

The Detroit Steel Corp. completed its $60,000,000 modernization and expansion program in February. The last unit to be finished was the new open hearth shop, consisting of four 250-ton furnaces. At the same time, the company's new 44 × 110-in. high-lift blooming mill and ten new 18-ft diameter soaking pits were put into operation. The company's pig iron capacity has been tripled to over 750,000 tons, and ingot capacity has been doubled to 1,300,000 tons annually.

Pittsburgh Steel Co. completed its $65,000,000 expansion program during the year with the opening of its new cold rolled sheet mill. This will raise its total shipment of steel products from 695,000 tons in 1950 to a present capacity of about 1,100,000 net tons. The new four-stand tandem cold strip mill is at Allenport, Pa. This plant also has facilities for annealing sheet steel, a four-high temper mill, two flying shear lines, a slitting line and packaging and shipping facilities. Sheets produced will range from 20 to 60 in. wide, and 12 to 28 gage in thickness. Cold rolled capacity is about 40,000 tons a month.

Another program, a nine-year $96,000,000 expansion at Allegheny Ludlum was completed on Sept. 28 with the installation of a 56-in. cold mill. This unit has an annual capacity of 300,000 tons of stainless, silicon and alloy steels, and is located at Brackenridge, Pa. Complete auxiliary equipment for continuous annealing, pickling and shearing is also installed.

Extended expansion is under way at Lukens Steel Co., Coatesville, Pa. This program includes such items as a 5,000,000-gal water reservoir and pump house, electric power station, a modern heat treat building, installation of a soaking pit and two holding pits, a 5000-ton plate flattening press, finishing and shipping buildings, an $800,000 continuous annealing furnace, a blast type plate cleaning machine, installation of nine torch powder scarfing machines for conditioning stainless steel slabs, and modification of the open hearth with the installation of an Isley stack system. The major project is a $10,500,000 item which covers the heat treatment building for large plate. Completion target for this program is May, 1955.

Expansion at McLouth Steel Corp. at Detroit is proceeding at a rapid rate, and the first blast furnace went into operation in September. Two new 200-ton electric furnaces were put in production, one in May and one in June. Steel capacity is now 1,250,000 tons. Five new 2-hole soaking pits which can handle ingots up to 34,000 lb are on the program.

McLouth also put into operation two new 547-ft ore bridges at Trenton. These bridges can handle 27,000 lb of ore in one bite, and hoist at 300 fpm.

The new 60-in., $25,000,000 hot sheet mill at McLouth was started in December. This unit can produce sheet steel up to 60-in. wide and has a capacity of 150,000 tons a month. Finishing speed is 2500 fpm. Mill will be used for carbon and stainless, sheet and strip steel. A four-stand tandem cold mill is a part of this program.

Granite City Steel Co. completed all major projects in their $50,000,000 expansion program during the year, increasing their annual ingot capacity from 700,000 to 1,200,000 tons.

Empire Steel Corp. in Mansfield, Ohio announced a program which will enable the company to produce cold rolled and silicon sheets in either coils or cut lengths, in gages from 14 to 30 and widths up to 43 in. This will be done on a new cold mill which will go into operation in 1955, and will be the final step in their $20,000,000 expansion program.

The Reeves Steel and Manufacturing Co., which is tied in with Empire Steel, contracted for a $3,000,000 program which will add a continuous hot dip galvanizing line.

A. M. Byers Co. are planning to install new facilities for the production of wrought iron pipe in sizes which comprise about one-half of their total pipe production at a cost of about $2,000,000. The company also announced it intends to enter the field of plastic pipe.

The New England Steel Development Corp. received an additional lease of life during the year when their certificate of necessity for a $26,000,000 electric furnace plant was extended for a six-month period. This eventually became a factor in the formation of a new company, the Northeastern Steel Corp., incorporated to make hot rolled specialty steels at Bridgeport, Conn. This company will acquire the present plant of the Stanley Works and will increase the capacity to 300,000 tons a year from the present 188,000 tons. Additional melting capacity will be provided through two modern electric furnaces which will supplement the present open hearth operation. A new bar mill is planned. Part of the present capacity will be used for production of carbon and alloy bars.

The Stanley Works plan to consolidate their cold strip output at New Britain after selling their Bridgeport hot mill.

Western steel capacity is still expanding at a rapid rate, and has now increased almost 3½ times since 1936. Principal increases are in the products consumed in the western states, such as pipe and tubing, reinforcing bars, etc.

A new rolling mill on the west coast started operations in June. This was the Pacific Steel Rolling Mills, Inc. at Seattle. Facilities include a 6-stand rolling mill for the production of small steel merchant bars and shapes.

The Columbia-Geneva Division of U. S. Steel took a six-month lease on 450 acres of land a short distance from its Pittsburg mill, reviving rumors of a new west coast plant. They are also prospecting for ore north of Vancouver, British Columbia, and small widely sepa-

Ore from storage at Puerto Ordaz moves to dock to ocean going ships at rates of 6000 gross tons per hr. This year saw first shipments from this new ore development to the United States.

rated pockets of magnetite ore have been located in British Columbia.

Another new electric furnace plant is being discussed for the Mount Shasta Steel and Tube Co. for the production of pipe, tubing, conduit and tin plate in northern California. The president of this company at one time promoted the $136,000,000 integrated Yolo Steel and Metal Co. at Sacramento, a proposal which has been discussed in this report some years ago.

FOREIGN PLANTS

In 1954, production of steel increased in practically every country in the world except in the United States, Canada and a few very minor producers. However, world-wide production declined from about 259,000,000 tons in 1953 to 245,000,000 tons in 1954 because of the drop in the United States and Canada. As a result also, production of the free world countries dropped about 18,000,000 tons to about 182,000,000 tons in 1954. On the other hand, production of steel by Russia and the other Red countries totaled 63,000,000 tons, up about 4,000,000 tons over 1953. The United States' margin thus declined from three to one to two to one.

Comparative productions for some of the larger steel producing countries are as follows, in net tons: United Kingdom 20,700,000, up 1,000,000, Western Germany 19,000,000, up 2,000,000, France 11,300,000, up 300,000, Belgium 5,400,000, up 400,000, Italy 4,500,000, up 700,000, Saar 3,100,000, up 100,000, Luxembourg 3,100,000, up 100,000, Sweden 2,100,000, up 100,000, Spain 1,200,000, up 200,000, Netherlands 1,000,000, up 100,000, and Yugoslavia 700,000, up 100,000.

Russia was the important Red steelmaking unit with 45,000,000 tons, up 3,000,000. Next was Czechoslovakia with 5,100,000, up 200,000, Poland 4,500,000, up 1,500,000, Eastern Germany 2,750,000 tons, up 350,000, Austria 1,800,000, up 300,000, Hungary 1,800,000, up 100,000, Rumania 900,000, up 100,000.

In the western hemisphere, the United States was down 23,200,000 tons to 88,400,000 tons. Canada was down from 4,100,000 to 3,100,000 tons. Brazil was up 100,000 to 1,200,000. Mexico was up 50,000 to 550,000. In the rest of the world, Japan was a large producer with 8,700,000, up 300,000 tons. Australia produced 2,500,000, up 200,000 tons. India was up 200,000 to 1,900,000 tons. China was up slightly to 2,000,000 tons and South Africa was up 100,000 to 1,500,000 tons.

Production of pig iron and ferroalloys in the world in 1954 was also about 173,000,000 tons compared with 184,000,000 tons in 1953. Production here again dropped because of the drop in the United States and Canada, and the remaining countries in general increased their production. Iron production in the United States totaled about 58,350,000 tons, in Canada, 2,500,000 tons, Great Britain 13,000,000 tons, France 9,700,000 tons, Saar 2,700,000 tons, Belgium 5,000,000 tons, Luxembourg 3,000,000 tons, Italy 1,600,000 tons, Spain 1,000,000 tons, Sweden 1,000,000 tons, Germany (West Zone) 13,500,000 tons, East Zone of Germany 1,500,000 tons, Austria 1,500,000 tons, Netherlands 700,000 tons, Czechoslovakia 3,300,000 tons, Poland 3,000,000 tons, Hungary 900,000 tons, Rumania 550,000 tons, Russia 32,000,000 tons, China 3,000,000 tons, Japan 5,300,000 tons, India 2,200,000 tons, Australia 2,000,000 tons, South Africa 1,300,000 tons, and Brazil 1,000,000 tons.

The construction of new steel plants throughout the world is resulting in a reduction in steel exports. Exports in 1953 of semi-finished steel totaled about 17,000,000 tons, which is under the 19,000,000-ton figure for 1929, and percentagewise it is much lower considering the much larger present capacity. As new plants go into operation, the figure will become less.

A great deal of attention during the year was directed at the program of Atlas Steels, Ltd. at Welland, Ont., who are incorporating many novel features into their plant expansion program. New equipment includes a continuous casting machine for stainless and specialty steels, a planetary hot strip mill, a continuous high-head heating furnace, and automatic powder scarfing units for conditioning stainless steel billets. It is believed that many of these items will be the forerunner of a number of similar installations in other plants. Full production of the plant will be attained early in 1955.

One problem which had to be solved in the shipment of Cerro Bolivar ore was designing the loading facilities to handle the 39-ft rise and fall of the river level.

Dominion Foundries and Steel, Ltd., of Hamilton, Ontario, started a $10,000,000 expansion program, which was carried out in 1954. Largest item in the program is the new steelmaking facility based on a top blown oxygen converter.

In South America, practically every major country has a program under way by which they plan to produce more of their own steel products and reduce the amount of their imports. Major plants are planned in Mexico; Venezuela is planning a 200,000-ton mill; Colombia started production on a 145,000-ton plant in November; in Peru a 60,000-ton plant is under construction. Major expansions are planned in Brazil, and Argentina is planning a 400,000-ton annual capacity plant. Some of these expansions are dependent on loans from the United States or through the export-import bank. These loans have met some opposition by the steel industry in the United States, which believes that it is wrong to finance steel capacity abroad when U. S. steel capacity is not operating fully.

In 1953, Latin America produced about 2,000,000 tons of the 6,000,000 tons which it requires. Most of this was done in plants built in the last ten years. By 1960 their programs will provide capacity of 4,000,000 to 5,000,000 tons.

Already in Colombia, even before the first ingot was produced, the government has barred the import of certain steels that will be produced locally.

Production of steel in Brazil in 1954 totaled about 1,200,000 tons. Of this, 710,000 tons was produced at Volta Redonda. Brazilian plans for expansion should increase steelmaking capacity 2,500,000 tons by 1956, and 6,000,000 by 1960. Included in the plans are a 900,000-ton a year steel mill at Vitoria, Brazil, and a 450,000-ton a year plant at Laguna, Brazil.

Brazilian National Steel Co.'s program includes a proposed $35,000,000 loan to raise ingot capacity from 782,600 tons to over 1,200,000 tons per year. Proposed expansion will include a cold mill, a breakdown mill, two open hearths, and a battery of coke ovens. A new 1200-ton per day blast furnace was blown in at Volta Redonda in February.

The proposed steel plant near Sao Paulo at Piassaguera is still in the wind. Initial capacity would be 300,000 tons, to be built at a cost of $150,000,000.

The Venezuelan government is planning to build a steel plant at Puerto Ordaz at the junction of the Orinoco and Caroni Rivers. Initial capacity is to be 150,000 tons a year at an estimated cost of $70,000,000. It is expected to be operating early in 1958. The Venezuelan government is receiving technical assistance from American companies now obtaining Venezuelan ore. The government will hold 51 per cent of the stock in the company. Ore will come from the Cerro Bolivar operation of U. S. Steel Corp. Initial production will be on structural shapes, reinforcing rod, pipe, wire, and plate.

Colombia's new steel plant, located near Belencito, was officially opened this year. This plant, recently renamed the Acerias Paz del Rio, was constructed at a cost of about $70,000,000, and has a rated capacity of 150,000 tons. Equipment includes one blast furnace, three basic bessemers, and one electric furnace for alloy steel production. In addition, the plant includes a rolling mill, wire drawing equipment, power plant, coke oven battery and coal chemical recovery system. Initial production will include rail and rail accessories, blooms and castings, structurals, bars, and wire products. Plans are under way to enlarge the plant to 250,000-ton capacity. With this expansion, the plant will be able to turn out flat rolled steel.

In Peru, a new contract was signed during the year to complete a steel mill with an initial capacity of 60,000 tons. Plant is located at Chimbote, Peru.

An Argentine company was the low bidder on a hot mill which had been originally built for the Czech government, and this will go to the Sociedad Mixta Siderugia, of Buenos Aires, Argentina. This company has a blast furnace on their program which is to be built at San Nicolas. An American concern received the order for the construction of this furnace and related facilities.

During the year Great Britain found it difficult to denationalize its steel industry and progress in general was slow. However, by the end of the year, the picture on British denationalization changed completely, and the five denationalized steel makers quoted on the stock exchange were selling at a premium over their issue prices. Just what caused the change is hard to tell, although high production of steel and consequent profitable operations were undoubtedly big factors. Involved in this program are 298 nationalized steel plants and their subsidiaries.

The first company offered, the United Steel Cos., Ltd., was put on the market in October, 1953, with 14,000,000 shares. These shares were well received, although they soon sold at a discount. The next company to be offered was Lancashire Steel Corp. The buying public stayed away from this offering and it was necessary for a group of eight underwriting London banks to take over this stock. In late June, the stock of Stewarts and Lloyds, was put on the market. This opened at a slight discount but in a short time was selling at a premium which gradually went up until the end of the year. In October, the denationalization agency offered 9,000,000 shares of Johns Summers & Sons and this is now also selling at a premium. This was followed with sales of Dorman Long and Co.

Up to the present time the British government has received about $300,000,000 of the $670,000,000 which was put out when the steel industry was nationalized. In addition to these sales, several companies were sold back to large steel-using industrial firms. These include five companies sold by private negotiation, namely Round Oak Steel Works, Sheffield Forge and Rolling Mills, District Iron and Steel Co., The Hallamshire Steel and Wire Co. and the Templeborough Rolling Mills.

An expansion program at Dorman Long provides for installation at the Cleveland Works of two new blast furnaces, a coke oven plant, a new blooming mill, a new medium section mill, and a high capacity rod and bar mill. This company will also construct at Lackenby a universal beam heavy section mill. It is expected that the coke ovens will be completed in 1955 and the beam mill in 1956.

The seven year reconstruction program for the French steel industry was completed late in 1953 or early in 1954. A new four-year program at an estimated cost of $714,000,000 is to be started in 1955. Capital improve-

ments in 1954 totaled about $258,000,000. There has been a trend in France to integrate a number of small firms into large units. As an example, seven plants owned by four companies were combined into the Societe des Ateliers et Forges de la Loire.

Steel production in Western Germany, in 1955, with present expansions complete and present business conditions, should run over 21,000,000 tons.

Full information is not available on the progress of the Russian steel industry. However, a number of items which have come out are interesting. Current designs of blast furnaces show that some of these units have an effective volume of 44,630 cu ft with hearth diameters of 26 ft and heights of 85 ft. Furnaces have 16 tuyeres of about 7 in. diameter. Almost all open hearth furnaces are fired with mixed coke oven and blast furnace gas.

In East Germany at the Peoples' Ironworks south of Magdeburg, ten low shaft furnaces are producing high grade foundry iron from iron ores containing from 17 to 30 per cent iron. Average output of these units is about 60 tons per day. Furnaces are built in the form of an elongated rectangle. Charge consists of an ore-lime-coal briquette which they find is cheaper than sintering.

In Poland the large Nowa Huta metallurgical center completed construction of one phase of its steel plant program. This steel combine, located near Krakow, is the largest industrial project in the Polish six year plan (1950-55). The units now at this plant consist of three tilting open hearth furnaces, a blast furnace, a blooming mill and a flat products mill. The plant also has three coking batteries which can each produce 1000 tons per day of blast furnace coke.

Equipment scheduled for Nowa Huta include a total of four 800-metric ton blast furnaces, ten open hearth furnaces with an annual capacity of 1,500,000 metric tons, and rolling mill capacity of 1,000,000 metric tons a year for structural steel, plates and sheet. The initial stage of the program completes only one-half of this capacity. Another program under way is the Stalin works previously known as the Laband Works, which is located close to Gliwice.

Other programs in Poland include renovation of the Bierut steel complex in the Silesian city of Czestochowa. At this plant, a modern tube mill was added in 1952 and two blast furnaces in 1953. A coke plant is also under construction at this location. The steel plant at Czestochowa is programmed for an annual capacity of over 1,000,000 metric tons. A new special steel plant is also under construction in Warsaw.

Targets under the Polish six year plan consist of 100,000,000 tons of coal production, 12,800,000 tons of coke, 3,000,000 tons of iron ore, 3,500,000 tons of pig iron, 4,600,000 tons steel ingots and 3,200,000 tons of rolled products (all metric tons).

Bulgaria started production at a plant near Nikolaevo called the Lenin Steelworks. This is the last eastern bloc country which did not have a steel industry. Two blast furnaces were under construction at this plant and four open hearths. The program is scheduled for completion in 1955. Steelmaking capacity at this time is estimated at 132,000 tons and will rise to 337,000 tons in 1956.

In Red China, a steel program is also underway. The largest project is located at Anshan, which before the war had nine blast furnaces and a steel capacity of 1,300,000 metric tons. These were demolished close to the end of the war, and are now being rebuilt. Plans include the construction of several blast furnaces, erection of new rolling mills and a seamless mill.

Work is going on in a number of other industrial centers, including Taiyuan in Shansi province, at Tientsin, at Tangshan, and at Shanghai which includes the restoration of five blast furnaces at Maanshan in the Shanghai area. Jobs are also scheduled at Tayeh near Hankow in central China and at Chungking. Another new steel center is planned at Paotou, which may surpass Anshan in Manchuria.

China's five year plan was started in 1953.

An American company completed contracts for the supervision and erection of extensive new steelmaking facilities for Tata Iron and Steel Co., Ltd. This project includes five open hearth furnaces, stockhouse, mold yard, stripper, three bessemer converters, two hot metal mixers and auxiliary facilities. Site of expansion is at Tata's plant at Jamshedpur. Work started in September, 1955, with completion expected late in 1957.

Another proposed steel plant in India, a 500,000-ton a year unit, was offered to India by the Russians at a price which it is not believed the west can match.

Present annual Indian capacity is 1,200,000 tons and the two new 500,000-ton plants under way and under construction will increase capacity to 2,200,000 tons.

A small 50,000-ton a year pilot plant is also being considered for Pakistan. This plant will be built to develop local ore.

RAW MATERIALS

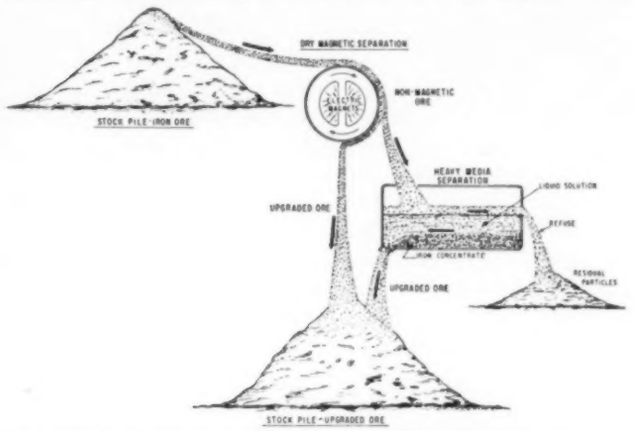
Most raw materials are now in ample supply, but there are six metals which are still short: cobalt, copper, molybdenum, nickel, titanium and tungsten. Although these are actually available, they are considered so strategic or so critical, particularly in the event of war, that government is sponsoring added capacity, and stockpiling the material.

In a Congressional Committee report, it was indicated that the government's mobilization program, which includes additional production capacities, stockpiles and emergency controls, is pretty close to its final

Kaiser Steel installed an ore beneficiation system at their Eagle Mountain, Calif., iron ore mine which boosts ore content from 51 to 56 per cent.

goals. The completion of this program will reduce government aid for plant expansion and will also make more readily available some of the materials which have been in short supply.

Ore — It is interesting to speculate on the future picture of iron ore. In 1951, of the 126,000,000 tons of ore shipped, 116,000,000 tons were produced in the United States and 10,000,000 tons were foreign. Very little concentrate was included in this figure. By 1960 it is estimated that ore produced in the United States will total 77,000,000 tons, but that 37,000,000 tons of foreign ore will be imported and 20,000,000 tons of concentrates will be produced, for a total requirement



The Eagle Mountain iron beneficiation process incorporates both magnetic and heavy media separation.

of 134,000,000 tons. It has been estimated that by 1980 United States blast furnaces will consume at least 40,000,000 tons of concentrate. A factor in this will be construction costs, for it has been estimated that to produce taconite pellets requires an investment of $30 to $40 per annual ton. Open pit investment costs run around $4 and underground mining runs up to $12 per ton, so there is an appreciable difference. An overall investment of up to $2,000,000,000 may be required. These additional costs may require a 20 to 25 per cent boost in future ore costs.

Regardless of the rate of operations in the steel industry, the extensive development programs under way for iron ore and iron ore sources will continue at their present high rates for a number of years to come. These programs are extremely essential for the future of the industry, and will involve perhaps the largest percentage of new capital funds for some time to come.

The 1954 ore shipping season opened on April 19 when the "Reserve" was loaded at Two Harbors, Minn., with 18,000 tons of iron ore pellets (63 per cent Fe) made from taconite. This was the first boat to carry a 100 per cent load of pellets. The material was mined and processed by Reserve Mining at Babbitt, Minn.

Because of reduced steel operations at the end of 1953 and early in 1954, there was an extensive carryover of ore stocks at the plants. As a result, iron ore shipments down the lakes had a slow start, and shipments throughout the season were probably about the lowest in fifteen years, totaling about 60,800,000 gross tons. Of the 275 ore carriers registered on the lakes, only about 80 per cent went into operation during the season. Practically all of them were laid up by the first of December. Ore stocks at the mills at the end of the year were about 50,000,000 tons and by the start of the shipping season next spring, will probably total about 20,000,000 tons, so there will probably be no great pressure to start the season too quickly next year. Total ore consumption in 1954 in the United States was about 96,000,000 gross tons.

During the year, a new ore carrier the George M. Humphrey was christened at Lorain, Ohio. This ship has the largest capacity of any carrier on the lakes, and can handle up to about 24,000 tons. Displacement tonnage is 31,650, length 710 ft, beam 75 ft.

The result of intensive development work in Venezuela by United States Steel was climaxed when the first shipment of iron ore from Orinoco Mining's Cerro Bolivar development was unloaded at the Fairless Works on January 20. Carrier of this ore was the freighter Tosca which left Puerto Ordaz on January 9, with 6000 tons. The ship could be loaded to draw only 21 ft of water to fit the channel above Philadelphia.

Orinoco Mining Co. officials estimated that they would ship about 3,000,000 tons of ore in 1954 from Venezuela and that this would be increased to 5,000,000 in 1955. At the end of the year, shipments were at a 5,000,000-ton annual rate.

It has been reported, however, that a disproportionate alumina-silica balance may cause operating adjustments in the Fairless furnaces to find the most efficient operation. U. S. ores yield slags running about 12 per cent alumina but the Venezuela material runs as high as 20 per cent.

It is also reported that United States Steel is considering the installation of a sintering plant at Fairless because the Venezuelan ore is more powdery than the U. S. varieties.

Until the Venezuelan mines get into full production, the United States Steel Corp. will use about 200,000 tons of Peruvian ore a month at Fairless and at the southern plants. This comes from a hematite deposit located near San Juan, Peru, 300 miles south of Lima. Even though the $1.00 per ton Panama Canal toll must be met, cost of this Peruvian ore may be lower than that of Venezuelan ore because of the pit's closer location to tidewater. Shipments from this location were started in 1953.

Iron ore started moving this year from the new Quebec-Labrador development. Shipments to the United States from this source may eventually increase to 20,000,000 tons a year. This development is estimated to have cost over $250,000,000. When operations get into full swing, ore will be moved over a new 360 mile railroad in trains of 115 to 117 cars each, powered by a four-unit, diesel locomotive. Cars will carry about 95 tons of ore each and the road will run about 7 trains a day during the shipping season. Loading facilities at the port terminal at Seven Islands can put 30,000 tons of ore aboard ship in five hours.

The first trainload of 60 cars of Knob Lake ore arrived at the port of Seven Islands on the St. Lawrence River on June 23. On July 31, the first boat was loaded with ore at Seven Islands. The first ship load of this ore arrived in the United States at an impressive dock-side ceremony in Philadelphia in August. The occasion also marked formal opening of the new $10,000,000 ore receiving facilities at Greenwich Point on the north bank of the Delaware River. Over 20,000

tons of high grade ore came on the cargo vessel S. S. Hawaiian, which took five days for the trip.

It is estimated that the Quebec-Labrador ore can move to inland blast furnaces in competition with ore from the upper lakes area.

In 1954 about 2,000,000 tons of ore were shipped from Labrador of which about 150,000 tons went to Lake Erie ports by small canalers. In 1955, shipments are expected to be about 10,000,000 tons, and this rate is planned for the ensuing five years.

Production from the Canadian field will be allocated at 27 per cent to Hanna, 25 per cent to Republic, 20 per cent to National, 10 per cent to Youngstown Sheet and Tube and Armco each, and 8 per cent to Wheeling. Bethlehem Steel has signed a 25-year contract with Hanna for 30,000,000 tons.

Other areas in Labrador are also under consideration. One large concession is located in the Goose Bay area and another area is located just south of the Knob Lake area. Other developments north of Knob Lake are being explored with the idea that summer water shipments may be made from the Ungava region.

Battelle Memorial Institute was retained to estimate the probable cost of an initial plant at Ungava Bay on the North Atlantic coast, which would be capable of producing 1,000,000 tons of iron concentrates annually. In the north Finger Lake deposit, which is close to tidewater here, there is an estimated 1,000,000,000 tons of iron-bearing materials. It is reported that this averages 30 per cent iron in a mixture of magnetite, hematite and gangue.

Battelle is consultant on another ore development, located close to the 365 mile railroad recently built by the Iron Ore Co. of Canada. A Battelle report shows an average iron content of 36 per cent Fe, which can be readily concentrated to 65.5 per cent Fe. Concentrated samples contain 5.2 per cent silica. The ore is a soft specularite, which is a variety of hematite. It is tentatively planned to concentrate the ore by means of a spiral process which uses the principal of centrifugal force. The concentrated product will probably be sintered with coal. Drillings have indicated the presence of 1,500,000,000 tons of ore.

One new development is located on Belcher Islands in James Bay, where preliminary exploration is going on. This location would provide direct boat shipments through Hudson Bay and the Straits in the open season. There are also two railroad lines which go to Hudson Bay. There, ore deposits are reported to average better than 52 per cent natural iron, although the silica content may be on the high side.

The Jones and Laughlin Steel Corp. took options on large iron ore deposits six miles from Kirkland Lake in Ontario, Canada. The option will permit J & L to explore the property for two years and will provide for leasing the property if the results are encouraging. Ore at this location is a magnetic taconite. Arrangements have been made for an equitable freight rate structure which will permit the ore to be brought economically to the Pittsburgh district.

A new iron ore pit, the Hogarth, was found in western Ontario, which will add to the reserves in the Steep Rock iron development. This ore analyzes at 61.5 per cent iron.

Inland Steel Co.'s program includes additional facilities at their Caland ore property in Ontario, Canada. This unit will not come into production until 1960.

Port Dolomite on Lake Huron will provide a new source of metallurgical limestone.

At the end of the year, the new iron ore project at Marmora, Ontario, Canada of the Bethlehem Steel Co. was nearing production after the removal of a hundred foot capping of limestone was nearly completed.

Bethlehem Steel Co. is also developing the Grace mine in Berks County, Pennsylvania and sinking of shafts continued throughout the year. Production of iron ore is expected to start late in 1957.

A new source of ore will also be the result of a new process developed by the International Nickel Co., which is planning to undertake the production of by-product iron ore from nickel ores in the Sudbury district of Ontario. The company is starting a $16,000,000 plant in the Copper Cliff area. The first unit will ultimately yield 1,000,000 tons of high grade iron ore a year, in addition to the nickel. The ore will contain at least 65 per cent natural iron, and will be suitable for direct use in open hearth and electric furnaces.

A possible new source of ore is being explored by a combination of National Lead Co. and Republic Steel Corp. The project is the upgrading of the lean non-magnetic ores which are found in very large quantities in the south and southwest. The first step in the project involves a big scale pilot plant, constructed at Republic's Spaulding Iron Mine near Birmingham, Ala. The upgrading process was developed largely by National Lead, who is interested in the metallic oxides for paint pigments. Iron content of the lean ores runs about 20 to 25 per cent. The process inolves changing the non-magnetic ore to magnetic, followed by magnetic recovery. Some of these ores contain titanium.

Investigations under way in the new pilot plant will be based on four different furnace principles: shaft furnaces, rotary furnaces, moving bed and fluidized bed. The change to the magnetic oxides will be accomplished by reduction through roasting.

Kaiser Steel Corp. completed a new plant designed to extract the maximum amount of iron ore from the high grade deposits at Eagle Mountain, Calif. Average iron content as mined is 51 per cent, and with the beneficiation process, it will increase to 56 per cent. The process uses a magnetic unit to extract the high

grade magnetite ore, and the hematite is then run through a heavy media process. The two ores are then combined for loading in railroad cars. The plant is designed to process more than 2,000,000 tons of ore per year.

In 1954, about 1,000,000 gross tons of taconite were shipped. Progress on the taconite program was steady throughout the year. Erie Mining Co., which is backed by Bethlehem Steel Corp., Youngstown Sheet and Tube Co., Interlake Iron Corp. and the Steel Co. of Canada, has under way a $300,000,000 project, at Aurora, Minn., planned for operation in 1957. It will have an annual production capacity of 7,500,000 tons of concentrate.

The Reserve Mining Co., owned by Armco Steel Corp. and Republic Steel Corp., is centering its activity at Babbitt. This plant started operation in June, 1952, and can now produce 300,000 tons per year. This company also was the source of the first shipload of taconite which came down the lakes last spring. Reserve has a much larger plant under construction, which will cost an estimated $160,000,000, scheduled for completion in 1957, with an annual output of 3,750,000 tons. Plant is so laid out that it can be expanded to an eventual 10,000,000 tons. This plant, however, is being constructed on Lake Superior instead of at the ore body, and is located near East Beaver Bay, Minn.

The third company in the field, Oliver Iron Mining, is operating a concentration plant at Mountain Iron, Minn. Concentrates are shipped to Virginia, Minn., where it is either sintered or nodulized. This project is primarily experimental, although it has an annual capacity of 500,000 tons. Oliver is reported to be in a better position as far as high grade iron ore is concerned, and will probably not go into full scale construction as soon as the other companies.

On the upper Michigan Peninsula, Humboldt Mining Co., owned by Ford Motor Co. and Cleveland-Cliffs Iron Co., has an operation which is concentrating iron oxides from hematite in a jaspar ore form. Present capacity is 200,000 tons. A heavy media process is used for the separation, which increases iron content from 33 to 62 per cent. At present, two more jaspar concentrating plants are planned, the first to have an annual capacity of 200,000 tons and the second, 400,000 tons. Production in 1954 was about 150,000 tons.

A new process for heat hardening pellets from taconite concentrates is being incorporated into Reserve Mining Co.'s new E. W. Davis Works at Silver Bay, Minn. This plant when in full operation will turn out about 12,000 tons of pellets a day. Advantages of the process are simplicity, heat recovery from the operation and quality control. A horizontal furnace is used which is about 200 ft long, through which travels a 6-ft wide traveling grate loaded with pellets. Balls are fed onto the furnace grate by means of an oscillating feeder at a rate of about 55 tons per hour. Steps consist of drying, preheating and burning. The burning starts a chemical reaction which gives a heat generation of its own. In the burning, the top layer is ignited, and the combustion progresses uniformly down through the pellet bed.

Substantial progress in determining physical and chemical properties of sinter has been made through a relationship between the physical properties and the magnetic permeability. This latter has been found to be a good index of physical strength, and since recording instruments can be put close to sinter bed to read magnetic properties, a good indication as to the sinter properties can be determined while the operation is under way.

Additional experiments during the year show that sintering rates are apparently increased directly with the moisture content, although they are independent of the coke content. Bulk density of the bed is inversely related to the coke content but independent of moisture. These tests also show that, although moisture has a direct influence on the sintering rate and other sintering conditions, it does not affect the properties of the sinters produced. The coke content does not affect the sinter rate, but has a marked influence on sinter properties.

The effect of additives was also tested in some experiments, and it was determined from these experiments and from the additives tried, that lime and calcium carbonate gave the best binding qualities. Other materials tried were either ineffective or not commercially feasible. By adding a small percentage of lime, strong sinter could be made with considerably less coke. Beneficial effect of lime increased to a limit of 4 per cent lime.

Scrap — It was previously stated that raw materials were not too much of a problem in 1954, and the reduction in the operating rate seemed to open up many new supplies. An example of this was scrap, whose price during the year fell to some of the lowest values for some time. Scrap business at times was extremely low because the ingot rate declined, and mills held on to their stocks, stretching them farther and farther, with the use of hot metal made available from excess blast furnace capacity. However, with the upturn of business toward the end of the year, demand increased and the price went up to about $36.50 for No. 1 and $33.50 for No. 2 heavy melting in Pittsburgh, from lows of about $24.00 in March. These were the highest levels since November 1953.

Appreciable quantities of scrap were exported during the year, and this is another factor in the scrap price. Although the Commerce Dept. refused to ban the export of scrap, it did cut down the time on export licenses to three months compared with the previous six months, also requiring a firm commitment on the part of the scrap dealer for the scrap he proposes to export. With these rules, the Commerce Dept. can step in quickly to reduce exports of scrap.

The George M. Humphrey, one of the most modern and largest ore carriers on the Great Lakes, was put into service this year.

A new factor in the scrap market was introduced during the year when future tradings of this commodity were set up in Chicago on August 1st. It is believed that this will even out some of the fluctuations in prices.

A new type of scrap baler went into operation at the General Motors Pontiac Division. This is a German unit, essentially consisting of two baling units, each capable of producing 5 tons per hour. One operator runs both balers. Each baler unit has three rams, two small ones opposing each other and one large one working at 90 degrees to the other two. A 4500-psi hydraulic system is part of the design. Scrap is compressed into 11-in. cubes which weigh about 60 lb.

At the other extreme, an extremely large scrap baler was installed in Georgia, designed to bale complete automobiles, trucks, etc. It has a charging box which is 20 ft × 6 ft 8 in. × 6 ft. Bale dimensions are 24 in. × 60 in. × 34 in.

Limestone — A new source of limestone was set up by United States Steel Corp. with the construction of a new shipping point called Port Dolomite, on Lake Huron, 34 miles south of Sault Ste. Marie. Here, the company has developed a large acreage of limestone property which will ship its first boatload of limestone in the spring of 1955. Chemical analysis of the stone shows about 45 per cent magnesium carbonate, 55 per cent calcium carbonate, and only one-half per cent of impurities.

Coal — Coal was no problem during the year and ample supplies were available. One advance in coal mining practice was shown by the United States Steel Corp., who developed a new coal miner. This unit somewhat resembles a giant chain saw and takes out 120 to 250 tons of coal each shift. It knocks down the coal through vibration of two hammers which strike the working face about 1800 15-ton blows per minute. The unit is 30 ft long and will tunnel into coal at 3.5 fpm. It is 54 in. high and 6½ ft wide. U. S. Steel has about 40 of these units in operation at the present time.

The work which has been underway on the underground gasification of coal in Alabama by the U. S. Bureau of Mines, and the Alabama Power Co. has not developed into a commercial operation. One of the problems is that the experimenters have not been able to get good contact between incoming air and the burning seam. Now under trial is a technique commonly used in oil field work which involves the pumping of kerosene, acid and sand into the coal seams. The kerosene-acid-sand combination pries the cracks of coal apart in the formation. The kerosene and acid are then pumped out, the sand wedges in the cracks and allows some air circulation.

Manganese — Supply of manganese eased in 1954, although U. S. output was still less than 10 per cent of need. Consumption in 1954 totaled about 1,800,000 tons of standard 46 to 48 per cent manganese ore.

Work continued on alternative sources of manganese supply. In one process under investigation, manganese will be obtained from open hearth slag by chemical treatment with a chloridizing agent. This investigation is sponsored by the American Iron and Steel Institute. Manganese is recovered as a chloride which can be converted to the oxide. By-products are pig iron and iron oxide.

A new leaching system entered the second phase of its program in the development of extraction of manganese from low grade domestic ores on the Cuyuna Range of Northern Minnesota. Commercial production started in September, and the plant is designed to produce 35 net tons of manganese carbonate daily.

Construction began on rail and port facilities to bring out manganese ore from Brazil's Amapa Territory. Shipments from this location are expected in 1956, and the agreement with Brazil permits exports of up to 500,000 tons of ore annually.

Late in the year, an announcement was made on a new manganese discovery in New Brunswick which will be of help to North American supply, particularly in time of war. The Strategic Materials Corp. announced that they had mapped out a deposit of at least 150,000,000 tons of manganese ore at Woodstock, New Brunswick, close to the Maine border. Full extent of the reserves is still to be charted. Although this is a low grade, 10 per cent ore, several unusual factors may make it an economical and competitive producer. One of these is the fact that the ore is magnetic in a non-magnetic gangue. As a result of a simple magnetic separation, manganese content can be doubled. In addition, discovery of a large deposit of pyrites, which is a rich sulphur-bearing rock, has been discovered in New Brunswick not too far from the manganese deposit. Since the sulphur leach process is one of the best for ore concentration, this pyrites deposit will enable the producer to further concentrate the ores economically. Plans are under way to build a mill which will produce ore within one year. An initial output of 320 tons of manganese a day, or 1/7 of United States consumption, is planned.

Nickel — Nickel production and capacity increased during the year, aided by various programs sponsored by the government. On January 26, the International Nickel Co. of Canada, Ltd., shipped from its Port Colburn refinery the first installment under its contract with the U. S. government for the delivery of 120,000,000 lb of nickel over a five year period. Deliveries will be made at a monthly rate of 2,000,000 lb until the contract is completed.

Nickel production by the free world in 1954 totaled about 390,000,000 lb. This is about 50,000,000 lb higher than 1953. Much of this was helped by government premium prices. Output by Canadian producers totaled about 320,000,000 lb, over 80 per cent of the free world's total. This compares with 286,000,000 lb in 1953. A big factor in the nickel picture is purchasing by the United States government for the stockpile. Production in 1955 is expected to hit 400,000,000 lb.

The price of nickel at the end of 1954 was raised by 4.5¢ per lb, and this should make more of the material available.

New sources of nickel which became available during the year were the Sherritt-Gordon Mines in Canada, which shipped about 500,000 lb a month in the last few months of the year, and National Lead Co.'s plant at Nicaro, Cuba, shipping about 500,000 lb a month for civilian use. When Sherritt-Gordon gets into full production, an additional 17,000,000 to 18,000,000 lb of nickel will be available. Next year, however, because of stockpile requirements, only about 7,000,000 lb will be available.

A $42,000,000 expansion program to double nickel

production was started by Falconbridge Nickel Mines, Ltd. This increase will raise capacity to 30,000 tons a year by 1960. A new refinery will be located near Port Colborne, Ont., along the route of the proposed St. Lawrence waterway. Falconbridge is also increasing the size of its Norway refinery by 50 per cent to a capacity of 22,500 tons annually. Falconbridge has contracted to sell 100,000 tons of nickel to the United States government.

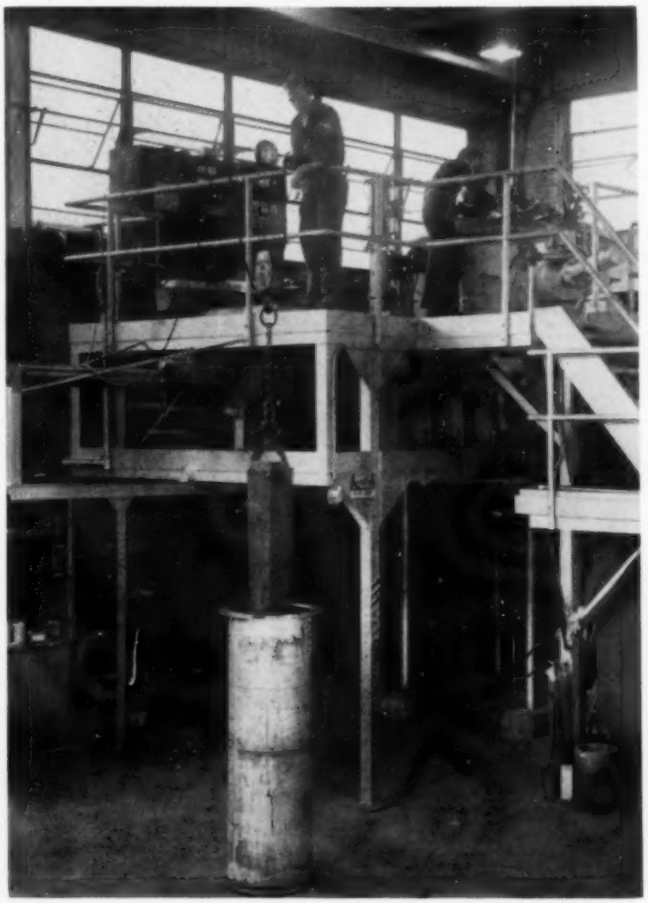
The Nicaro Nickel Co., a subsidiary of Freeport Sulphur Corp., is spending $35,000,000 on its nickel mining operations at Moa Bay in Cuba, and $18,000,000 on a 50-ton a day pilot plant near New Orleans. The pilot plant is working on a new process entailing leaching with sulphuric acid for extracting nickel and cobalt from the Cuban ore. Freeport Sulphur's long term program is 30,000,000 lb of nickel a year and 3,000,000 lb of cobalt.

National Lead Co. is also planning to carry out a $43,000,000 expansion program on the government-owned nickel plant it operates at Nicaro, Cuba, which should expand annual plant capacity to a total of 49,000,000 lb in 1957. The Nickel Processing Corp., a subsidiary of the National Lead Co., has operated this plant since 1950. The plant was originally developed and previously operated by the Nicaro Nickel Co., a subsidiary of Freeport Sulphur Co.

The Bethlehem Steel Co. is also experimenting with processes for recovering nickel from iron ore which they mine in Cuba.

Two electric smelters went into production at Hanna Nickel Smelting Co.'s plant at Riddle, Ore., to produce nickel from low grade ores. Four 26-ft diameter, tilting type electric furnaces are used at this plant. Molten ore is smelted in the electric furnaces with ferro-silicon. With violent agitation, the molten nickel is reduced to ferro-nickel. Additional operations are then used to dephosphorize. An additional two furnaces are scheduled to be ready in the middle of 1955, at which time the plant should be producing 16,000,000 lb of contained nickel a year in the form of ferronickel ingots. It is believed the entire output is scheduled for the government stockpiling program.

Vacuum steel making appears to be a coming process for very high grade steels and alloys.



Aluminum — Aluminum maintained its high production during the year and kept most of its added capacity in operation. Aluminum production for 1954 totaled 2,900,000,000 lb. Except for one reduction plant, the industry's so-called second round expansion is now complete.

One of the important trends in aluminum was the increase in shipments of aluminum foil, which totaled about 150,000,000 lb, some 30 per cent over 1953. Price of aluminum pig at the end of the year was 20.5 cents a lb and had increased 0.5 cents a lb during the year.

In August, the Office of Defense Mobilization cancelled the scheduled third round of expansion which would have boosted aluminum capacity by 400,000,000 lb. The agency stated that a review of mobilization needs, including Canadian supplies, eliminated the need for this particular tonnage. This third round expansion program was announced in October 1952, and contemplated having several new independent aluminum producers entering the field, as well as increasing capacity amongst present producers.

The first aluminum ingot was poured in August at Aluminum Co. of Canada's new Kitimat, British Columbia plant. This climaxed three years work on the new plant, which can be expanded to an eventual capacity of about 550,000 tons. Present smelting capacity is about 91,500 tons.

A multi-million dollar aluminum sheet and foil rolling mill was announced during the year by Kaiser Aluminum & Chemical Corp. This will be built in the Ohio River Valley near Ravenswood, W. Va., and will be the tenth major aluminum facility of that company. Construction will start around January 1, 1955, and the first stage will be completed in the middle of 1956. Facilities will have an annual capacity of 72,000,000 lb of light gage aluminum sheet and foil. Heavy gage coiled strip will be supplied from the corporation's Trentwood plant. The second stage will make the plant a fully integrated rolling mill with an annual capacity of 250,000,000 lb of commercial sheet and foil products, processing aluminum pig from the Chalmette plant at New Orleans. The plant will have a mill rolling foil at speeds up 3000 fpm.

Magnesium — Although the magnesium supply has been ample, there was a possibility that this situation might be reversed, due to the possible shutdown of the government-owned plant at Velasco, Texas. At the present time, seven magnesium plants exist, of which six are owned by the government and one is privately owned by Dow Chemical. Of these, only three are producing magnesium. The operating plants are located at Velasco, Texas, Freeport, Texas, and Canaan, Conn. Freeport, the privately owned plant, has an annual

capacity of 30,000 tons; Velasco, the plant which was to be shut down, has a capacity of 45,000 tons; and the Canaan plant, which is operated by the Atomic Energy Commission, has a capacity of 5000 tons. Velasco has been operated by Dow under lease from the government. This lease ran out on October 31st and the plant was put up for sale with the only bidder Dow Chemical. The Justice Department would not approve their bid because of alleged monopoly reasons. After a great deal of bickering, Dow Chemical Co., finally signed a three-year contract with the GSA to operate the Velasco plant on lease.

Titanium — The titanium industry continues to grow. At present, about seven companies have entered the field or have announced plans to get into production. Present capacity comes primarily from two plants with a total combined capacity of about 7200 tons. Production of titanium sponge in 1954 was about 5000 tons. In the programs already outlined, capacity in 1955 will be about 10,000 tons, and the government's goal is 37,500 tons by 1956. The latest company to go into the titanium picture is the Electro Metallurgical Co., who signed a contract with the government which will result in a plant at Ashtabula, Ohio, having an annual capacity of 7500 tons. However, instead of using the conventional Kroll process, the plant will use a new process based on sodium reduction of titanium tetrachloride.

The Henderson, Nev., plant of Titanium Metals Corp. of America was completed late in 1954 to its capacity of 3600 tons. DuPont's plant in Newport, Del. reached its capacity of 3600 tons in April, 1954. Another plant at Chattanooga, Tenn., operated by Cramet, Inc., with a proposed annual capacity of 6000 tons, was started late in 1954.

Rem-Cru Titanium, Inc. was awarded a certificate of necessity for a $13,000,000 plant to develop and process titanium, which will increase the firm's capacity of 2500 to 11,150 tons annually.

Early in 1955, a commercial titanium powder plant is scheduled to start operation. Initial capacity will be about 5000 lb per month. This will be the first such unit

For the first time, a price schedule was set up for titanium, based on cost. Price of titanium sponge at the beginning of the year was set at $5.00 a lb. This gave a base price of $9.00 per lb for titanium billets. By the end of the year, these prices had gone down to a base price of $4.50 a lb for the sponge.

Titanium remelting furnaces have increased in size and an automatic double melting furnace now in use remelts 4000 lb of titanium ingots. Consideration is also being given to double melting furnaces for producing 8000-lb ingots.

New processes for producing titanium appear promising and one of these at the present time is an electrolytic process. It has been successfully used in the pilot plant stage.

A new titanium discovery in the southern part of Mexico, about 350 miles from Mexico City, was developed by Republic Steel. The ore which is rutile has a titanium dioxide content running as high as 97 per cent, in contrast with 26 to 28 per cent titanium dioxide occurring as ilmenite. This makes it the richest known deposit in this hemisphere. The first mine to go into operation, at Las Minas de Tisur, should start before the end of 1954. This has proved reserves of 25,000,000 tons of rutile, and is only part of the overall set-up.

Copper — Copper was in fair supply during the year, although there were spot troubles due to strikes. Current projects now under way in the United States will provide a net increase of productive capacity of 250,000 tons of copper annually by 1956, a gain of more than 25 per cent over 1953 capacity. These include eleven new copper mining projects, both open pit and underground. Of these, six have already started production. In these projects alone, known reserves are over 1,000,000,000 tons of ore.

Cobalt — The International Nickel Co. started production of electrolytic cobalt at its Port Colborne refinery in Ontario. This starts the first commercial production of this material in Canada.

Chromium — The first commercial production of electrolytic chromium started at a plant on the Ohio River during the year. This plant has a capacity of 2000 tons, and will supply chromium bearing alloys for high temperature applications.

BLAST FURNACES

In the United States the large sizes of the newer blast furnaces have increased average daily output. The American Iron and Steel Institute reported that in 1953, an average of 919 net tons were produced in a blast furnace daily. Thus for the first time this country's average has exceeded 900 tons. Only 25 years ago it was 655 tons. The furnaces in the east are highest with 1146 daily tons, western furnaces average 980.4 tons, midwestern furnaces 910.7 tons, and southern furnaces 704.8 tons. The AISI also pointed out that among the new furnaces there are nine units which are able to produce 500,000 tons a year and two were under construction at the time of the report. Bethlehem Steel's J furnace at Sparrows Point set what may be a world's record last May by producing 61,424 tons or a daily average of 1981 tons.

The blast furnaces built in 1954 include one for McLouth Steel at Trenton, Mich.; one for American Steel and Wire at Cleveland, Ohio; one for Dominion Steel and Foundries in Canada. Bethlehem Steel Co. also completed its B furnace at Bethlehem in the early part of the year. Under construction at Great Lakes Steel Corp., is a new furnace at Ecorse, Mich. Hearth diameter of this is 30-ft 3-in. which would make it the largest in the world.

On September 21, the American Steel and Wire Division of U. S. Steel put into operation their new furnace at Cleveland. This unit has a capacity of 1350 tons of pig iron a day and will be operated as a merchant furnace. Every effort was made in the design of this furnace to eliminate air and stream pollution. The furnace is equipped with the latest designs in dust catcher, gas washer and electrostatic precipitators. Hearth diameter is 26 ft 0 in. The furnace is 228 ft 6 in. high from yard level to top of furnace.

McLouth Steel Corp. also started its new blast furnace in September. This unit has an annual capacity of 1,200,000 tons and is one of the big units in the company's expansion program.

The honor of being the largest blast furnace in Europe changed hands several times during the year. On

July 29 it was given to the new Queen Victoria at the Appleby-Frodingham Steel Co. plant, a unit of United Steel Companies at Scunthorpe in Lincolnshire, England. The honor was previously held by the Queen Anne furnace, which was blown in on March 1, 1954. These units are designed to handle a local ore which starts with an iron content of 20 to 21 per cent. The Queen Anne furnace has a hearth diameter of 27 ft and effective volume of 42,372 cu ft. The Queen Victoria furnace, which was originally designed similar to the Queen Anne, was changed to give a hearth diameter of 28 ft 6 in., a bosh diameter of 31 ft 9 in. and an effective volume of 44,351 cu ft. The hearth bottom on this new furnace consists of 5 ft 4 in. of carbon over 10 ft of firebrick. Both hearth and bosh walls are of carbon, while firebrick is used in the stack. Three hot blast stoves are used for each furnace which have a total heating surface of 100,000 sq ft each. The gas cleaning plant uses three tower washers and five electrical precipitators. This plan is common to the two furnaces. The Queen Anne furnace which was designed for an output of 6000 tons per week produced 7390 tons of iron from extremely lean ores the same week the Queen Victoria was blown in.

Also under construction in England is a 29 ft 0 in. blast furnace at Margam, Port Talbot, Wales.

The honor of being the largest blast furnace in Europe was also held for awhile by a furnace at the Westfalenhutte A.G., Dortmund, Germany, which was blown in on December 18, 1953. Hearth diameter is 26 ft 6 in., but because of the different European method of measurement is equivalent to about 27 ft 6 in. by American practice. Bosh diameter on this furnace is 31 ft 0 in. This German furnace has a brick work bottom 10 ft 6 in. thick and on top of this is a carbon bottom 6 ft 8 in. thick. The carbon consists of machined blocks approximately 36 in. x 12 in. x 16 in., installed in five courses. Blocks are interlocked, and the outside blocks are tied down by the blocks in the hearth wall. A minimum of $\frac{1}{32}$ in. clearance is used between the blocks. There is no paste or tamped carbon between the blocks although a 2-in. clearance between the outer edge of the carbon blocks and the welded steel shell is filled with a mixture of carbon paste and tar. This unit has no hearth cooling castings, but uses spray water on the outside of the hearth jacket. The cooling water is collected in a trough at the top of foundation which leads it off to the furnace drain. The bosh, which is also cooled entirely by sprays, is lined entirely with carbon blocks. Refractory brick work starts at the top of the bosh. Cooling castings are used from here on up to the wearing plates to preserve the refractory linings. Furnace operates on about a 44 per cent Fe burden.

One interesting development is the small capacity blast furnace. These are of no particular importance in the United States, but some of the countries now developing steel industries have a place for them. These units would produce from 10,000 to 15,000 tons a year using ores with a low Fe content, perhaps under 30 per cent, and would use solid fuels. At Lausanne, Switzerland, a pilot plant has been set up to try the use of such materials in such furnaces. The unit in this plant has a special recuperator which operates at gas temperatures up to 2900 F and gives a blast temperature at the tuyeres of about 1100 F. The unusual feature of this furnace is that the hot gases, instead of going upward through the charge as in the conventional furnace, are drawn downwards into the bottom of the recuperator. This flow also prevents hanging of the charge in the shaft. However, a great deal more work is needed before this furnace can be profitably evaluated.

Pressurized operation of blast furnaces received further recognition during the year when the United States Steel Corp. signed a license agreement to use this process. However, U. S. Steel reported that it is not planning to convert all of its furnaces, but plans to first use the process on a limited commercial scale. About thirteen licensed pressurized furnaces were in operation in the United States during the latter part of the year.

The application of carbon refractories to blast furnaces has received increased acceptance. According to experimental results obtained by one producer, it appears that this application will be primarily to bottoms, and on the walls up as high as the bosh.

One blast furnace operator reported he has been able to sustain maximum production of pig iron in furnaces having hot spots through the use of a four-point program which extended life an average of 13½ months. The program involves weekly pyrometer checks to detect hot spots; use of shell sprays to protect thin linings and to aid in building up protective coating; pumping grout inside the furnace shell through nipples in the hot spot area; and the use of copper dovel-type cooling plates which are installed by staggering them in rows over the affected area and the use of shell sprays over these cooling plates.

The Ford Motor Co. has been doing extensive experimental work on radioactive materials in blast furnaces. In one test, over 76 tons of radioactive ore were fed into the Benson Ford blast furnace to determine the feasibility of using fine iron powders as a part of the charge. These powders are particularly prevalent when concentrating low grade ore. About 60 per cent of the iron particles were retained during the smelting process, but this was considered too small a percentage to make such charging practical.

Report on a new venturi washer for blast furnace gas was given during the year, based on data from a pilot plant with a nominal capacity of 25,000 cfm of gas and also a plant scale washer with a capacity of 85,000 cfm of gas. Dirt content of cleaned gas is dependent on the gas pressure lost across the venturi section. The range tested covered a dirt content of 0.09 grains per cu ft at a pressure loss of 7 in. of water to a dirt content of 0.015 grains per cu ft at a pressure loss of 24 in. of water. The gas pressure loss depends upon gas flow rate and water ratio. Water required for cleaning was about 5 gal per thousand cu ft of gas rather than the 20 gal per thousand cu ft for conventional primary washers. This should result in smaller thickeners. No blockage occurred in either the venturi sections or the cooling towers during the year of operation of the pilot plant and nearly two years of operation of the plant scale unit. There has been no sign of wear or erosion of the venturi linings.

The cleaning installation for ferro-manganese furnaces which was put into operation in July 1953 at

U. S. Steel's Duquesne Works has given satisfactory operation. The units clean 135,000 cfm of gas and about 105 tons of dust are collected per day. As little as 0.15 grains of dust per cu ft can be removed from the gas. The ferromanganese dust, which is extremely fine, is particularly difficult to remove. Equipment combines gas conditioning towers, electrostatic precipitators and dust handling equipment. After collection, the dust is removed, mixed with water, briquetted and put into storage. Experiments are under way for processing the briquettes which are high in manganese to make them suitable for recharging into the blast furnace.

It was reported by a Canadian ore sintering plant that the service life of dust collector linings increased from a period of weeks when steel shells were used to as much as seven years with the use of silicon carbide brick.

An American furnace company was licensed to sell a sintering process in this country using square pans which are carried by a special crane. Equipment consists of pans, roller table, pan dumping machine, charging equipment, combustion stands and ignition car all arranged in a line. The materials to be sintered go by gravity to rotary feeder tables or belt conveyors which in turn feed to a common belt conveyor which automatically weighs the batches. This design lends itself to plants with capacities up to 3000 tons of sinter in 24 hours.

Electric blast furnaces were ordered during the year for a plant in Brazil. Each of these units will be capable of producing 100 tons of pig iron per day. One of the reasons for their use is the shortage of metallurgical coal in Brazil. Units are 90 ft long and 22 ft wide and have port-hole side charging of raw materials. They are similar to nickel reduction furnaces built before the war.

A direct reduction process was developed for operation in Venezuela which will reduce fine ores from screenings at the Cerro Bolivar project. In this process ore from a pulverizer, after being dried, is transported by air to a reduction furnace which reduces it to iron. This is then fed to a hot metal furnace which has the ordinary iron and slag tap holes. The fuel used consists of either coke oven, natural or a regenerative gas manufactured from fuel oil.

Some coke plant operators reported that data correlating coke made from unwashed and washed coals with corresponding iron production showed that to get increased tonnages of iron, the furnaces must be charged with metallurgical coke made from a blend of carefully selected, high quality, low-volatile coals with uniformly low ash, high-volatile coal. The strongest coke came from a mixture or blend of 35 per cent Pocahontas and 65 per cent washed Wheelwright, and this produced the largest quantity of iron. Less efficient operation was obtained when the coke was made with unwashed Wheelwright coal. They reported also that the benefits in the blast furnace operation were so pronounced that the minor disadvantages of washed coal should be tolerated in judging the value of this coal.

There has been a great deal of coke oven construction in the past few years although much of this represents rebuilding in which added capacity and increased efficiency has been attained. As an example, United States Steel Corp.'s large plant at Clairton will have been completely rebuilt as soon as the present program is complete. At the present time there are 23 batteries at Clairton, 22 of which will have replaced previous batteries and one is a new battery added in 1948. The corporation recently obtained certificates of necessity to rebuild No. 1 to 6 batteries and No. 10, 11, and 12. At the present time the work schedule is not set. Since 1945, U. S. Steel has rebuilt batteries No. 13 through 22. Batteries No. 7, 8 and 9 are under construction.

In the beginning of the year United States Steel Corp. closed down the last of its old beehive ovens in the Connellsville, Pa. coke area. This was done as a result of the drop in the demand for steel and consequently for coke. Last units were located in Fayette and Westmoreland counties.

One plant reported that its experience with coke ovens showed that, when they are idle for extended periods of time, maintenance cost can be reduced through partial insulation of the batteries and they also found that the batteries were kept in better condition when this was done. They found that the best procedure is to remove oven doors, and bulkhead oven openings with a 9-in. fill of vermiculite. The charging hole openings are then sealed with a steel plug and vermiculite fill. Standpipes are insulated with a loose fill. With this method of insulation, they estimate fuel gas required to keep the battery hot will be reduced between 55 and 60 per cent, which would pay for the insulation in four months.

STEELMAKING

For the first time in a number of years, it was possible to operate steelmaking furnaces without pushing them to the extremes which have been practiced during and since the war. Since it was necessary to close down complete shops at times, and since a large portion of the time most shops operated only at partial capacity, it was possible to catch up on much long needed maintenance and rebuilding work.

The pattern of future steelmaking and what direction new units will take is not yet clear. Whether the trend will be to electric furnaces, to the conventional open hearth, or to the oxygen-blown converter seems now to await the completion of several facilities under construction and data on their operating results. Since pressure at present is not on expansion, it is a good period to evaluate present methods to decide what way to take in the future.

In the open hearth, past years have shown a tendency to charge more and more into the furnaces in order to get increased production. As a result there has been some extension in the heat times. One reason for this is that there has not been sufficient capacity in the auxiliary facilities to melt the charge. Most units have need of greater preheated air volumes and temperatures, and checker chambers, flues, valves etc. have been insufficient in many units. Some of these omissions are now being remedied.

Pilot plant work is still going on in the turbo-hearth. This process is an interesting field of development although more work will be required to properly evaluate it for production uses. In the process, however, blows of 10 tons have been made in large numbers in the ex-

perimental unit, with blowing time of 10 to 12 minutes. Because of the surface blowing and the turbulence due to the shape of the vessel, a low nitrogen content of 0.002 to 0.003 per cent is being reached. Steels match conventional open hearth steels in physical properties and it appears that it will be particularly applicable to low carbon steels which require large ductility since the process will produce these quite rapidly.

The first installation of the Linz-Donawitz process in which oxygen is blown through a lance over the bath of a converter vessel went into operation this year at Dominion Steel and Foundries Co. Iron is essentially a basic iron with a high manganese content. The first unit of the three planned for McLouth Steel went into operation in late December, 1954.

The electric furnace held its own during the year and the largest units in the world went into operation at McLouth Steel. Further studies of the economics show that the electric furnace will produce carbon steel grades economically in competition with cold iron open hearth plants. These facts have been borne out clearly enough so it is questionable whether open hearth plants will be built again to use cold charges. However, where large production is involved which requires hot metal, it is still doubtful that the electric furnace will ordinarily compete successfully. It is difficult to add hot molten iron to the electric furnace. However, if an oxygen blown converter is used to refine hot metal to molten steel, this can be charged into the electric furnace since the lack of an oxidizing atmosphere in the electric furnace is not then detrimental. This is the procedure contemplated for McLouth Steel, where it is planned to use substantial amounts of blown metal (up to 40 per cent of the charge) along with scrap in the 200-ton electric arc furnaces. This combination should give high production rates, greater than any that can be obtained from the largest open hearth furnaces.

New electric furnaces at McLouth Steel have a shell diameter of 24½ ft making them among the largest in the world.

McLouth's oxygen steelmaking unit will eventually be a three-vessel shop each capable of producing 1200-1500 tons per day of steel, depending somewhat on the phosphorous content in the hot metal. About 40 tons of steel can be refined in a 20-minute oxygen blow.

The patent rights to the top blown oxygen converter process were acquired by an American company which is pushing this process in this country. It is reported that three plants are operating in Europe, one plant in Canada and one in the U. S. It is estimated that oxygen blown converter capacity will be up to 1,000,000 tons by 1955. The process will handle a wide range of pig iron analyses and it is claimed that the quality of the steel is as good and as closely controlled as in open hearth practice. Scrap metal charges of up to 25 per cent can be used. Production rates for such converters are as much as three times higher per hour than for the conventional open hearth furnaces, and operating costs, exclusive of metallics and fixed charges, are $3.00 per ton of steel less than similar costs for open hearth steel. Capital costs are estimated at 50 per cent less than a comparably sized open hearth shop. About one cu ft of oxygen is needed for each pound of steel.

One disadvantage of the oxygen blown converter is that it blows large quantities of dust and fumes out of the converter. These could cause a pollution problem if allowed to escape to the atmosphere. Dust is produced at a rate of more than 30 lb per ton of pig iron and 65 per cent of the particles are smaller than one micron, according to one report.

Thus, one of the problems to be solved by McLouth Steel Corp., is the removal of the particles from the gases coming from their three 35-ton converters. The method to be used involves placing large hoods over the top of the converters as the process starts. The fumes and smoke then pass through a spark arrestor or flame trap box, then go through a gas washer and into disintegrators. The effluent from the electric furnaces at this plant will also be trapped and directed into the same disintegrators. Two gas washers are to be constructed for the plant.

The rapid increase in steelmaking capacity in the country has been accompanied by a greater rise in the average capacity of furnaces. Since the war, the average capacity of furnaces per heat has gone up 30 per cent to about 160 tons. Total number of open hearths, which was 990 in 1945, went to 934 at the beginning of 1954.

Even new installations are being rerated for higher capacity. At Fairless, the open hearths originally rated at 275 tons per heat, have been rerated to 290 tons, and are actually producing about 315 tons.

Another example is Inland Steel who rerated their ingot capacity as of January 1, 1955 to 5,000,000 tons up from the 4,700,000 tons at the beginning of the year. This was done without new installations for the second year in a row. The 1954 increase of 300,000 tons supplements a 200,000-ton increase in 1953. Gain came from enlargement of existing furnaces, improved designs and better equipment and techniques, including extensive use of oxygen.

One steelmaker increased ingot tonnage from his open hearth shop through the installation of auxiliary corner burners which use oxygen and coke oven gas. As a result of observations on several campaigns, the operator reports that tap-to-tap time was reduced 1.90 hr or 14 per cent. The fuel was reduced 8.5 per cent per heat and 8.8 per cent per ton, and production was increased almost 17 per cent.

There is some indication that there are advantages to the top-charge elliptical arc furnace equipped with six electrodes, which may be faster and more efficient than circular furnaces with the same rated capacity. One such unit has been in operation for some time. This is a 100-ton furnace with an elliptical hearth 29 ft on the major axis and 20 ft on the minor axis. This unit is equipped with two sets of 18-in. graphite electrodes. It has a normal charge of 215,000 lb. The melting rate on this furnace runs higher than that of a 20-ft diameter circular furnace in the same shop which uses an 185,000-lb charge. The circular furnace is equipped with 20,000 kva transformer and the elliptical has two 7,500 kva units.

Another interesting development for electric arc furnaces is a sealing ring which is incorporated in the electrode glands. This electro-magnetic sealing ring goes into operation when the electrode carries current and provides a seal between the gland and the electrode. When there is no current on the electrode, the seals are automatically disconnected.

Induction stirring is receiving attention, although there have been some reports of troubles from refractory erosion. A new type of stirrer is under construction for one of the steel companies in the Pittsburgh area.

In the steelmaking field, vacuum melting is leaving the stage of limited production and is rapidly expanding. Present operating capacity is about 25 tons per week compared with about 8 tons per week in 1953. New units going into production have much larger furnace sizes than the present units which can produce ingots from 300 to 1000 lb. In the next few years furnaces of two- to five-ton capacities will be built.

By the end of 1954, Vacuum Metals Corp. was expecting to have in operation a one-ton furnace at Crucible's plant at Syracuse, N. Y. This would be the largest unit of this type in the world, and would have a capacity of 80 tons per month.

One large operator is engaged in a program which will multiply its capacity several times within the next year and four additional firms are planning to start production. One of the reasons for this expansion is the development of high vacuum equipment which will give satisfactory operation and service.

One of the problems, as opposed to ordinary melting operations, is that there is no direct access to the melt and provisions must be made for carrying out all operations without breaking the vacuum in the batch type units. On the other hand, vacuum melting enables the development of materials which cannot be processed by ordinary methods, and in some cases some compositions can be made which cannot be done without the vacuum.

Present melting costs are high and are estimated at from $1 to $3 per lb. It is still, however, considered worthwhile because the operation pays off in yield, workability, ductility, and improved fatigue strength, plus extremely close tolerance of composition limits. It has been recently estimated that the cleanliness of vacuum melting is ten times that of electric furnace operations. As an example of the increase in yield, in the case of one high temperature material, the yield goes from 45 per cent in the case of air melting to 65 per cent for vacuum melting.

The importance of scrap quality on steel production was reported by a Canadian steel company during the year. With care in scrap selection, they found that there was an increase of about 2 per cent in the average ingot yield. In addition, there was a reduction in the sulphur and a decrease in the slag volume.

Control of sulphur to meet specialized steel requirements is becoming an ever more difficult problem, since it takes 20 per cent more slag volume to meet a 0.025 sulphur specification than a 0.030 specification. To find raw materials which can meet the 0.025 specification economically is quite difficult. The answer may be in the work done at places like Stewarts and Lloyd in England, at their Corby plant. Here blast furnaces are run to give maximum production and the sulphur is allowed to come where it will. Then the iron is treated with soda ash after it comes out of the blast furnace to remove the sulphur and this eliminates this job from the open hearth. This is a practice which will probably eventually come in American steelmaking.

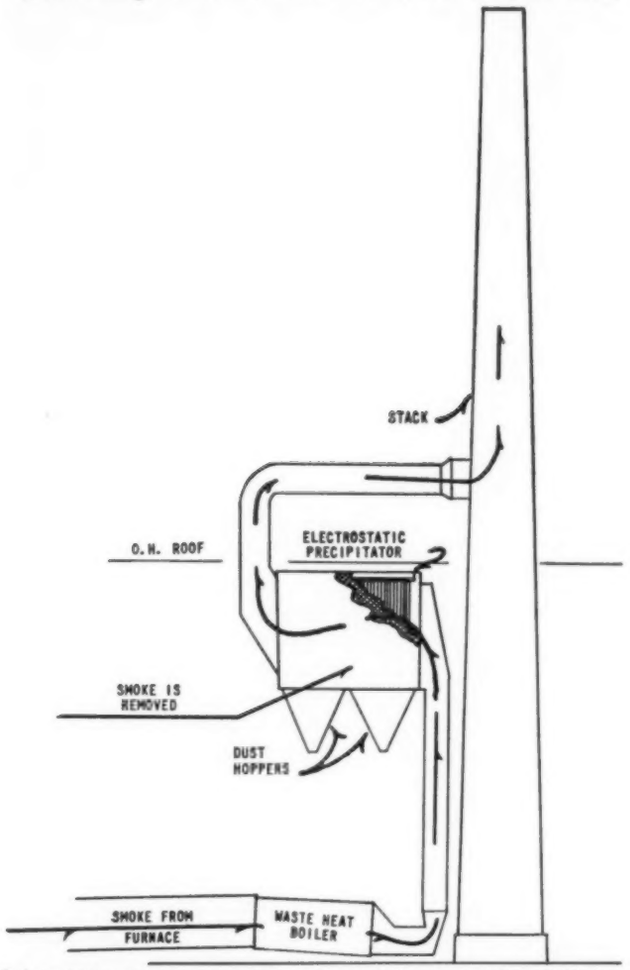
It was reported that one company is blowing argon gas through molten steel in the steelmaking operation in order to eliminate soluble gases. As a result, mechanical properties are improved.

An application to the open hearth department which offers definite economies is a mechanism known as a ladle addition feeder. This mechanism allows a greater amount of manganese to be added to the ladle in open hearth steelmaking than is normally regarded practical. The unit controls the rate of making the addition and also provides for making the addition at the correct location. Results from one plant show that the manganese consumption can be reduced because the yield from the ladle addition is greater than from a furnace addition, and manganese additions can be calculated lower without missing heats on the low side. The manganese spreads from ladle tests at first, middle and last ingots are also reduced. Economies of from 10 to 30 cents per ton of ingot are claimed, depending on the grade of steel produced.

The use of electrostatic precipitation for dust removal in steel plants has grown by leaps and bounds. As an axample of the installations of such precipitators, three are in use in iron ore sintering machines at T.C.I., and two more are under construction for sintering units at the Columbia-Geneva Steel Division at Geneva. The three T.C.I. units will clean a total of 450,000 cfm of gas, and the Columbia-Geneva precipitators will clean a total of 280,000 cfm of gas. In addition, Columbia-Geneva are installing eight precipitators to clean gases from 10 open hearth furnaces at Geneva. The same company installed four such units at Torrance, Calif., in 1951. At the Fairless Works of U. S. Steel, two precipitators have been installed to clean gases from hot scarfing machines, one precipitator in the slabbing

mill and the other in the blooming mill. The slabbing mill unit is designed to clean 20,000 cfm of gas at 90 F with 95 per cent efficiency, and the one in the blooming mill will handle 75,000 cfm of gas at the same ratings. Five electrostatic precipitators are installed at the Duquesne Works of U. S. Steel for cleaning gas from the ferro-manganese blast furnaces. All of these units are equipped with a new magnetic impulse rapping system which dislodges material accumulated on the collecting electrodes, and thus converts the process from an intermittent one to a continuous operation with improved efficiency and reduced maintenance.

At the Edgar Thomson works of U. S. Steel, air cleaning equipment was installed last year to clean all the gas from the plant's seven blast furnaces. Equipment includes dust catchers, spray towers, and electrostatic precipitators for final cleaning.



Schematic shows operation of precipitator on No. 3 Kaiser Steel open hearth.

Kaiser Steel put into operation an electrostatic precipitator on their No. 3 open hearth during the year. As this unit was started, it was also announced that a precipitator with a 50 per cent larger capacity was being built for No. 9, and two more precipitators have been authorized. No. 9 precipitator was scheduled for operation in December. The unit on No. 3 is designed to operate at an exit dust loading of less than 0.12 grains per standard cu ft. It now handles 26,000 standard cfm of gas at an average exit dust concentration of 0.08 grains per standard cu ft. Dirty gases are cleaned at 450 F by 50,000 volts impressed across 360 electrodes and 84 screens.

Work on a new method of cleaning gas was done at a European pilot plant during the year. In this method, fumes travel from bottom to top, counter-current to a water spray from a spray nozzle. The gas then goes through a venturi tube of rectangular section with three vertical spray nozzles placed at the throat. Side sprays have one nozzle and the center spray has two and this results in a continuous mist at the throat. From this, the material goes through a cyclone collector with vertical water sprinklers half way up, which spray water vertically to complete the dust precipitation and to wash the tower walls. Both incoming and outgoing fumes enter and leave the tower tangentially to the wall, thus throwing the sludge to the outside. The principal use is for eliminating the red fumes from the bath when the oxygen lance is used. Possible applications are for handling the fumes from oxygen blowing in converters. A recovery of 99 per cent or better of the free dust is possible, based on the performance of the pilot plant.

A report on operation with open hearth waste gas analysis control shows that roof life improved when the control is in service. In addition, a major benefit may be reduction in furnace refractory costs.

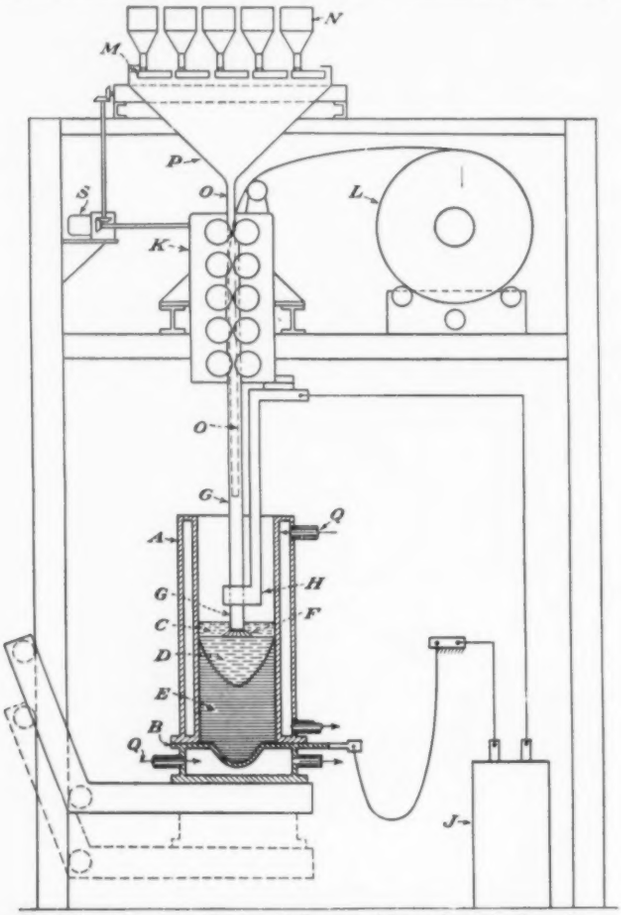
Steel production has been aided by many ingenious applications of power equipment to increase productivity. Among such developments is the use of highlift trucks for dumping dolomite on the doorsills of the open hearth. Mobile cranes on wheels find effective applications in handling hot metal or scrap charging. Equipment such as back hoes applied to the charging machine is helpful in knocking and raking out debris from the roof during a furnace rebuild.

Open hearth maintenance may be reduced by a method which will cut the time of cleaning slag pockets. In this system, the downtake has a refractory deflector which directs the gas flow to the bottom of the pocket. Here the slowing up of the flow allows the entrained matter to drop to the bottom where steam jets blow the deposits underneath the furnace endwall into a separate compartment where a cleanout ram moves the matter to the outside in a continuous operation. It is claimed that the design also decreases the tap-to-tap time and increases heat recovery. In addition, checker lancing is eliminated.

Operations at Green River Steel Corp. have shown the success of the novel process in use there in the production of sound, clean steel. The method used requires no hot tops. Yield is increased about 12 per cent higher than with conventional methods. Fully killed steelmaking practice is used, the steel being poured into big end-up molds that have a very heavy taper. After stripping, these go through soaking pits from which they are sent to an upset and forging press. After a second soaking, they are rolled. The top of the ingot is round, 28 in. in diameter, while the bottom is a 12-flute contour, 19 in. in diameter across the valleys. Because of the heavy taper in the ingot, pipe cavity is quite shallow and the segregation zone is a cone-shaped mass about 6 in. in diameter and 6 in. deep immediately beneath the pipe cavity. The upsetting process isolates this zone, forcing the sound portion of the ingot down and upsetting the area which is later to be cropped. Thus, the actual cropping takes away only

the inside section in which the defects are segregated. The shape of the ingot, however, after the upsetting action is such that it cannot be rolled due to the taper, and is put in a forging press where it is shaped to 61 in. sq by 9 ft long and thus put in a rollable condition.

Another method of increasing yield, found economical for high alloy steels, has been hot topping in which the heating is done with gas. One steel plant in Dunkirk has increased recovery by more than 4 per cent with this method. The steel in a shallow refractory hot top



Sketch shows equipment for making electric ingots.

is kept molten by means of an oxygen-natural-gas flame. As a result, practically all the metal in the hot top flows into the ingot, leaving a minimum of excess metal at the top. Maintenance on the equipment has been low and no special personnel or equipment are required. This particular installation consists of 60 water cooled burners to which oxygen and natural gas are piped.

In some experimental work done at a French steel plant, tests were made on an exothermic technique for pouring ingots. In the method, cast iron hot tops are lined with an exothermic flat refractory plaque. This effects a reduction in the feedhead and an increase of 10 per cent in the sound metal above the ingot neck.

United States Steel Corp. put into operation this year a new ingot mold foundry, which will have a capacity of 275,000 tons of ingot molds annually. The foundry is extremely modern and incorporates the latest material handling equipment, sand slingers and other means of making better and more economical molds. Sand slingers are capable of ramming sand at a rate of 1,000,000 lb in 24 hours.

A new type silica brick was installed in a furnace in the Chicago district. It is claimed that this refractory will stand up under higher temperatures than any other silica brick. If operation proves out claims, it is possible that it may be possible to produce alloy steels in the open hearth that now have to be made in the electric arc furnace or in a basic-lined unit. It is claimed that the brick will stand temperatures up to 3200 F. The method of manufacture is completely different, and the brick instead of being baked in a kiln at 2400 F (the usual practice) for ten or eleven days, is heated in an oven at 380 F and can be produced in 24 hours. The binder is phosphoric acid.

Even though mill operations were cut back somewhat this year, most mills which have been using quality refractories continued with them during the lower operational period because they found that the quality refractories paid. In applications where conventional silica brick were replaced by super-duty silica brick in critical areas of open hearth furnaces, it has been found in general advisable to continue with their use. More basic brick is also being used, particularly in such applications as the port ends. This eliminates the silica drip into the slag pockets.

In steel plants also, there is a very definite trend toward the use of castable and plastic refractory materials.

The placement of castable refractories with air-guns is becoming more prevalent, and this year such castables accounted for about 2 per cent of the total value of all refractories in the United States.

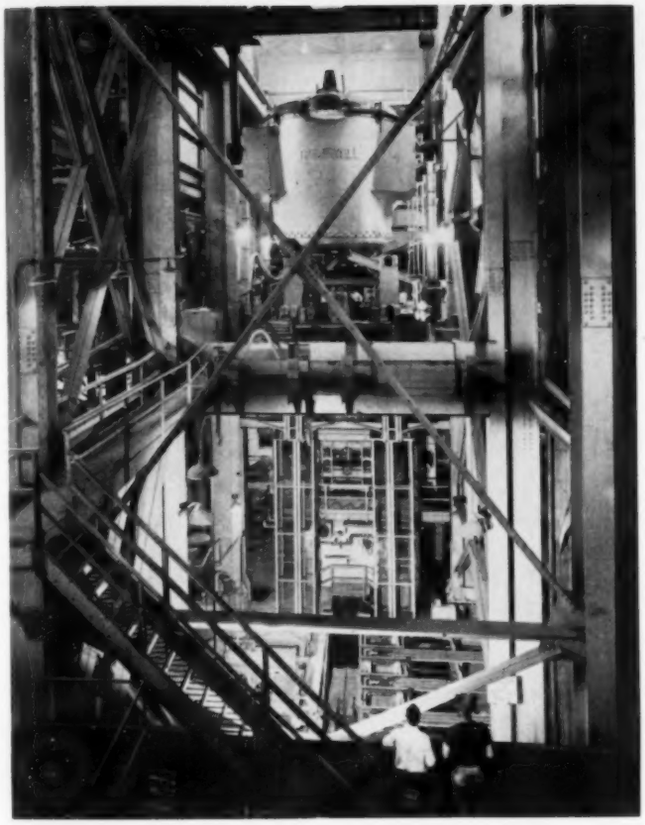
At Keystone Steel and Wire Co., one of two all basic open hearth furnaces is in operation. This unit has a flat, straight hung, suspended basic roof which in October had made 237 heats without repairs. The flat section is quite unlike the conventional curved roof. Performance is reported to be very good.

A new coating called solution ceramics provides a flexible heat resistant coating for many applications. They are not brittle and can be applied to almost any clean surface at only a few hundred degrees F. They contain no adhesive or binding agent. Thicknesses can be accurately controlled and can be varied from a few millionths of an inch up to one hundredth of an inch.

The more refractory coatings can be used to protect metals against molten metal or slag. They may be stamped after coating. In essence the process consists of spraying a true solution on the product being coated. Coatings on which most of the test work has been done are the refractory metal oxides such as zirconia, chromia, titania, ceria, magnesia, etc. However, the process is not limited to such compounds.

This year the first full scale continuous casting machine for steel on a production basis went into operation on the north American continent, at Atlas Steels, Ltd., Welland, Ontario, Canada. The unit is capable of casting billets or slabs in the range between 4 x 4 in. and 6 x 24 in. by using the proper molds. It is believed that casting speeds can be attained up to 100 in. per minute.

The heart of the equipment is a water-cooled, copper mold weighing from 1000 to 3000 lb. This mold has no bottom except when the run is started. About 20 seconds after pouring starts, pinch rolls begin to with-



Continuous casting machine at Atlas Steels, Ltd., is built on four levels. From top to bottom there is a floor with mold and attendant equipment, below it, the floor where cast metal is sprayed with water, below this, the pinch rolls, and on the ground floor is the cut-off room.

draw the starting bar with a newly formed hot billet from the bottom of the mold. At this time, synchronized machinery begins to oscillate the water-cooled mold. In this oscillation, the mold moves downward approximately ¾ in. at the same speed as the bar and then returns at a much greater speed to the original position, its sides sliding over the newly formed billet being withdrawn. High pressure water sprays are used to hasten the cooling.

A good deal of work was done by the British Iron and Steel Research Association on the problem of rupturing of the skin of the billet in the mold during continuous casting. This is apparently due to a combination of high frictional resistance between the billet and mold surface combined with low tensile strength of the billet skin. Data has been obtained in this research work on both the friction and billet strength values.

As a result of this knowledge it is proposed that the molds be spring mounted. When this is done, sticking between the mold and billet causes the mold to move with the billet. The tensile forces increases gradually and is dependent on the spring coefficient and the billet speed. After a certain amount of movement of the spring, the frictional force is overcome and the mold moves upward very rapidly even faster than in the reciprocating system. Spring coefficient is so set up that the tensile strength of the billet skin is not exceeded. The spring coefficient used will depend on the breaking strength-time curve of the steel being cast, and this will vary with the type of steel, size, and solidification rate.

In the two more widely known present continuous casting systems, one method applies a reciprocating motion to the mold and in the other method, the billet is withdrawn intermittently. Both of these techniques were developed to minimize the problem of rupturing the billet skin. The new method developed by the British Iron and Steel Research Association has not been applied to any operating installations so far as is known.

In a new non-ferrous plant recently put in operation, automatic control of direct chill continuous casting of magnesium rounds and ingots has turned out to be feasible. The unit processes rounds from 6 to 18¾ in. in diameter and rectangular ingots of 11¼ x 42 in. The molten metal is pumped into the mold through an electrically heated pipe.

ROLLING

In rolling mills the trend has been toward more speed with consequent added production, and if possible, with the production of better quality material.

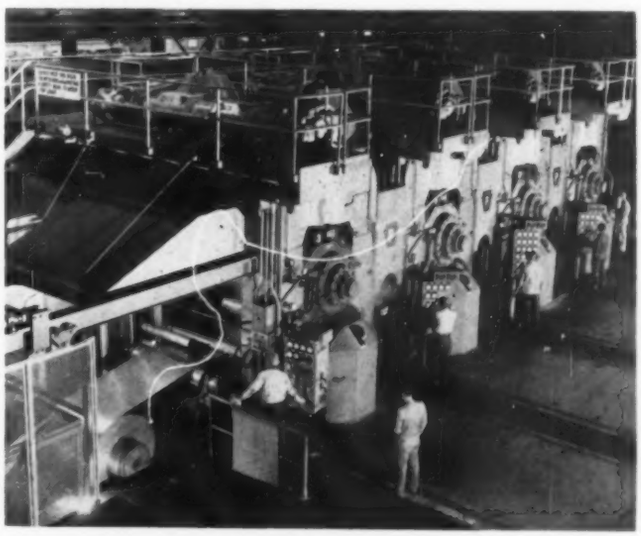
At the Fairless plant, which has the largest concentration of new rolling mill equipment, most of the units have been setting turn records of all kinds. Another example of excellent productivity is the new 44-in. blooming mill at Aliquippa, which broke its own old records on several occasions. One record set was the rolling of 576 ingots totaling 2534 tons in one eight-hour turn, averaging 72 five-ton ingots per hour with a high of 76 ingots in one hour.

The Youngstown Sheet and Tube Co. modernized their old 40-in. blooming mill at their Brier Hill Plant and installed a 44-in. stand in February. This unit is operated by a 25,000-hp steam engine originally installed in 1913, which also received a major overhauling.

Kaiser Steel replaced their 36-in. blooming mill with a new 46-in. high-lift blooming mill. New mill started production on November 16. It took less than nine days to dismantle the old mill and install the new unit.

What may be the world's largest ingots for flat roll-

Pittsburgh Steel installed a new 66-in., 4-stand, 4-high tandem mill.



ing are being reduced on Great Lakes Steel Corp.'s new 45 x 90-in. universal mill. This unit, with 16,000 hp on the main drives, rolls 20-ton ingots from 94 x 82 x 25-in. down to 4½ x 76 x 182-in. slabs. Automatic scarfing prepares the top and bottom of the slab. The mill has a manipulator on only the exit side. Horizontal rolls are 45 in. in diameter by 90 in. long and open from 2¾ to 79½ in. A special conveyor carries away the crop ends.

Newport Steel Corp. in Newport, Ky. completed a 4-high hot reversing strip mill as part of their $9,000,000 expansion program. The new mill will enable the company to produce lighter and wider coils and sheets. Newport is one of the few plants in the country where strip is rolled direct from ingot to finished coil in one straight line operation. The new reversing mill is much heavier than the unit which it replaces. It can produce coils up to 48 in. wide, in thicknesses from ¼ to 1/16 in., in a full range of steel analyses. Roll sizes are 26 and 49 x 66 in., driven by a 4000-hp, d-c reversing motor with a direct drive through a pinion stand. A cold rolling mill should be in operation in early 1955.

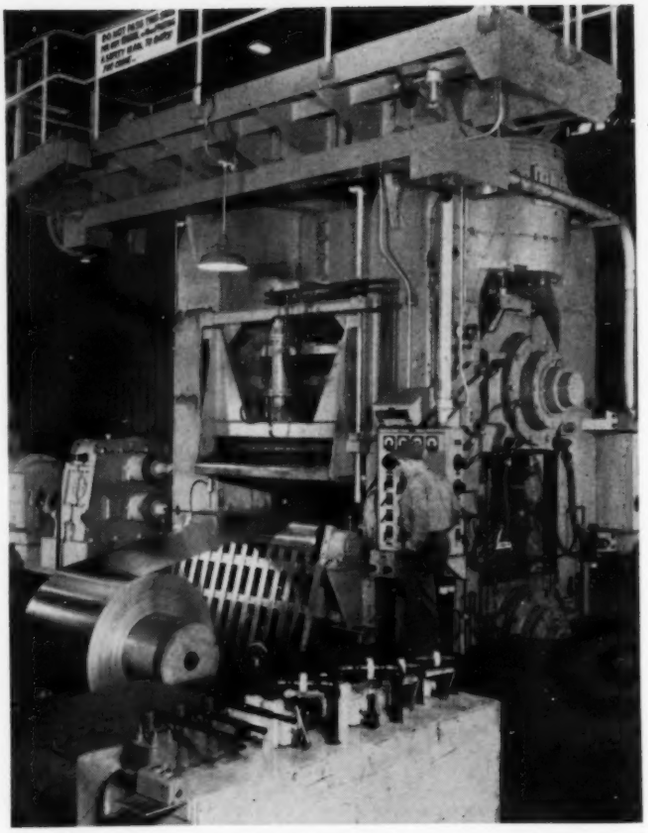
Atlas Steels, also started its new planetary hot strip mill. A company in the Pittsburgh area also has ordered such a unit.

One of the new features of the pickle line at the Fairless works is the installation of a two-high temper mill directly in the pickle line. Coils are processed at the entry end of the pickle line in the normal manner, passing through a processor, welder, and looping pit. At this point, a two-high 32 x 80-in. temper mill is placed in the line and an elongation of two to three per cent is made on the strip. This elongation breaks up a considerable amount of scale not loosened by the processor, and lessens the amount of acid required to clean the surfaces of the metal.

Research work comparing alloy steel and iron work rolls in the early stands of the finishing train of four-high hot strip mills indicates that there may be advantages to the use of steel rolls. It is reported that production is increased markedly over that of the iron rolls and the tonnage obtained more than makes up for the difference in cost. One reason is that the steel rolls can remain in a mill up to two times as long as the iron rolls on similar widths and gages. In addition, less dressing is required on the steel rolls to eliminate the fire cracks. In practice, the steel rolls are concaved slightly instead of using a crown.

A versatile rolling mill for small companies where tonnage requirements do not justify separate mills for skin passing, cold reducing, and tempering was installed recently at the Follansbee, W. Va. plant of Follansbee Steel Corp. This unit can reduce and skin pass light or heavy gage material. It can be used as a four-high mill with 4½ and 16 x 20-in. rolls, or it can be used as a two-high mill with 21 x 18-in. rolls. The same motor and drive are used in both cases.

Dow Chemical put into production the first wide magnesium plate mill in October, 1953. This 84-in. four-high hot mill at Madison, Ill. is used for breakdown and semi-finishing. No reheating is required while rolling from 10 in. to 0.200 in. Continuous cast, 2000-lb, 76 x 41 x 11 in. magnesium ingots are used. As a result of this operation, the output of flat rolled magnesium products exceeds for the first time the output of cast magnesium products. Plates weighing up to 1800 lb are being produced.



Two 1400-hp motors in twin-drive arrangement are used on this 53 x 66-in., 4-high temper mill.

One difference in the operation from that of steel is that, instead of using flame scarfing units, the equipment for this mill consists essentially of a large milling machine which removes surface metal to a depth of ¼ in. or more from top and bottom faces of the ingot. The mill is equipped with double screwdown drives, arranged to give the necessary high speeds for roughing work as well as the more accurate, slower speeds for semi-finishing. Mill is reversed for roughing, and with the addition of a coil box is ready for semi-finishing. Rolling practice is somewhat similar to steel mill practice but after the initial reduction, the ingot reductions are generally increased percentagewise. The mill is driven by a 6000-hp motor.

A new type of mill also went into operation in the aluminum industry at the Davenport Works of Alcoa. This 144-in. unit rolls tapered aluminum sheet and plate up to 10 ft wide. Breakdown operations are done on a 144-in. roughing mill and a 100-in. hot continous mill. Lengths up to 40 ft are available and the maximum thickness at the heavy end can be 1.50 in.

The aluminum industry is pushing the sales of aluminum, and as a result the market has developed, and a number of new aluminum foil mills have gone into operation. One of these was built for Kaiser's Permanente, Calif., plant. This mill reduces aluminum from 0.026 to 0.00025 in. at speeds up to 3000 fpm. The mill, a 60-in. unit, can handle foil up to 54 in. wide.

The new electric weld pipe and casing mills at Lone Star Steel Co. of Texas have several unusual features. There are two complete tube forming and welding

units. The smaller will produce 2 to 6⅝-in. outside diameter pipe in thicknesses from 0.125 to 0.337-in. at speeds up to 150 fpm, and the larger mill will make 4½ to 16-in. outside diameter pipe with wall thicknesses varying from 0.125 to 0.557-in. maximum, at speeds up to 120 fpm. These mills are essentially improvements of earlier designs, but have several new features, including the ability to produce casing from multiple width slit stock and to use coil stock up to 0.375-in. thick. Another innovation is a flying automatic rotary cut-off machine for 16-in. pipe.

A high speed unit has been developed which will cold form, induction weld, and size thin gage tubing of non-ferrous materials. This tubing has been primarily produced by hot processes in the past. The principal problem of welding non-ferrous materials is the abrupt melting point which prevents the use of high speed operations. In the new mill, however, the material is cold formed at speeds up to 150 to 250 fpm. Induction welding is done at speeds of 40 to 120 fpm. A great deal of development work was necessary in order to overcome the various welding problems. Mills using this method have been installed in a number of plants.

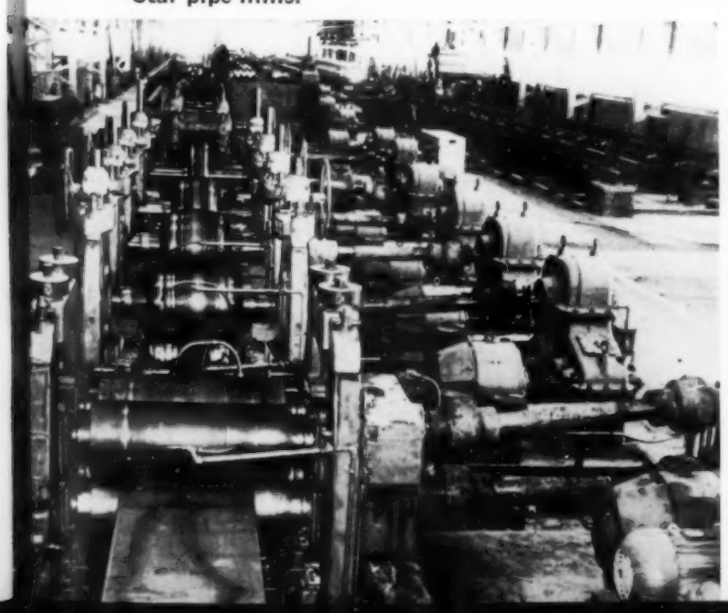
The Jones and Laughlin Steel Corp. put into operation late in the fall a new unit for the production of high strength steel tubing for the oil industry at its Aliquippa plant. The unit will specialize in two kinds of seamless tube, one with a tensile strength of 80,000 psi and another with a strength of 110,000 psi. One of the features of the installation is the very modern gas-fired furnace which is used in heat treatment of the pipe.

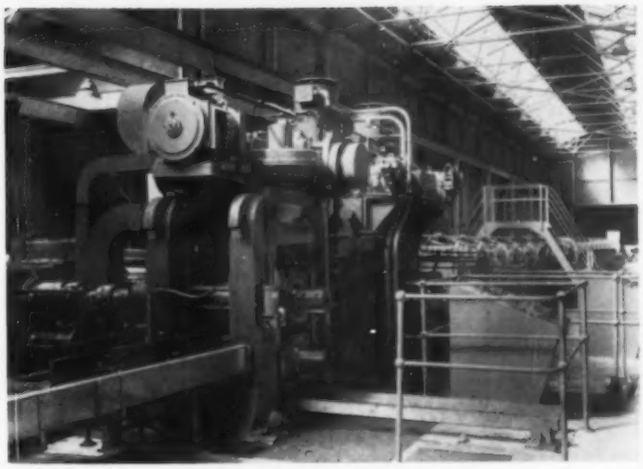
National Tube Division of the U. S. Steel Corp. went into production on plastic pipe at the Gary Works. The extruder will produce pipe from one-half to six in. in diameter. Included in the materials to be used are polyethylene and polyvinyl chloride. Development work is also still going on at McKeesport. Other newcomers include the Naugatuck Chemical Division of U. S. Rubber Co., and Tube Turns Plastics, Inc., Louisville, Ky.

Production of plastic pipe in 1954 was estimated at about 30,000,000 lb.

There has been a great deal of work done on rod mills in converting some of the older units from two-strand rod to three-strand operation. One such job was done at the John A. Roebling Sons plant of the Colorado Fuel and Iron Co. Another such job was done on the 16-stand rod mill at the Steel Co. of Canada, Hamilton, Ontario, which was rebuilt to a three-strand, 20-stand mill.

Forming mill uses eight pairs of driven rolls and three pairs of idler rolls on the larger of the two new Lone Star pipe mills.





Hot planetary rolling mill shown may reduce slabs 15-in. wide by 1¾-in. thick down to 0.040 in. in one pass. Mill is located at Wednesfield, England.

Colorado Fuel and Iron announced also that they will modernize their 16-stand rod mill at the Buffalo Plant of the Wickwire Spencer Steel Division. The rebuilt mill will be a 20-stand installation rolling three-strands at maximum delivery speeds of 4400 fpm.

The new high speed rod mill put into operation by Continental Steel Corp. at Kokomo, Ind., is a 22-stand, three-strand unit, producing a complete range of sizes from $\frac{7}{32}$ in. up to $\frac{43}{64}$ in. in diameter. It is also set up so that it can in the future produce sizes up to 1⅛ in. diameter rounds or equivalent cross sections. A 2½-in. square billet is used and the finished size determines the number of mill stands to be used. The mill has operated at delivery speeds up to 5750 fpm. Rod is produced in coil weights up to 600 lb.

A new combination rod mill now being installed at American Steel and Wire plant in Cleveland is designed to operate at higher speed, roll from larger billets and produce heavier rod bundles with greater output capacity than any rod mill of its type. Horsepower for main drives is 13,500 applied through nine main drive motors. The mill consists of 25 two-high roll stands, the first 15 of which will operate as a continuous roughing and intermediate train with automatic crop and cobble shears between the ninth and tenth stand. After leaving the continuous roughing and intermediate train, the bars may go to a two-stand looping mill and thence to a group of pouring reels, or alternately, may continue straight ahead to an eight-stand continuous finishing mill and thence to a group of laying reels. The unit is intended to operate continuously with four strands side by side throughout the mill. The final delivery speed of small rods from the last finishing stand will run up to about 6500 fpm. Starting billets will be 3½-in. square by 30-ft long to enable finishing 1200-lb rod bundles. Normal product range will be from No. 5 rod up to 1⅛-in. rounds.

A new 20-in. bar mill started production at the Joliet, Ill., plant of Phoenix Manufacturing Co. This mill in-

creases the company's capacity for producing billet and axle steel bars and special shapes from 15,000 to 150,000 net tons a year. It consists of a 20-in., three-high breakdown stand, four stands, of 12-in., two-high and two stands of 10-in., two-high finishing mills. Product ranges from ⅜ to 2½ in.

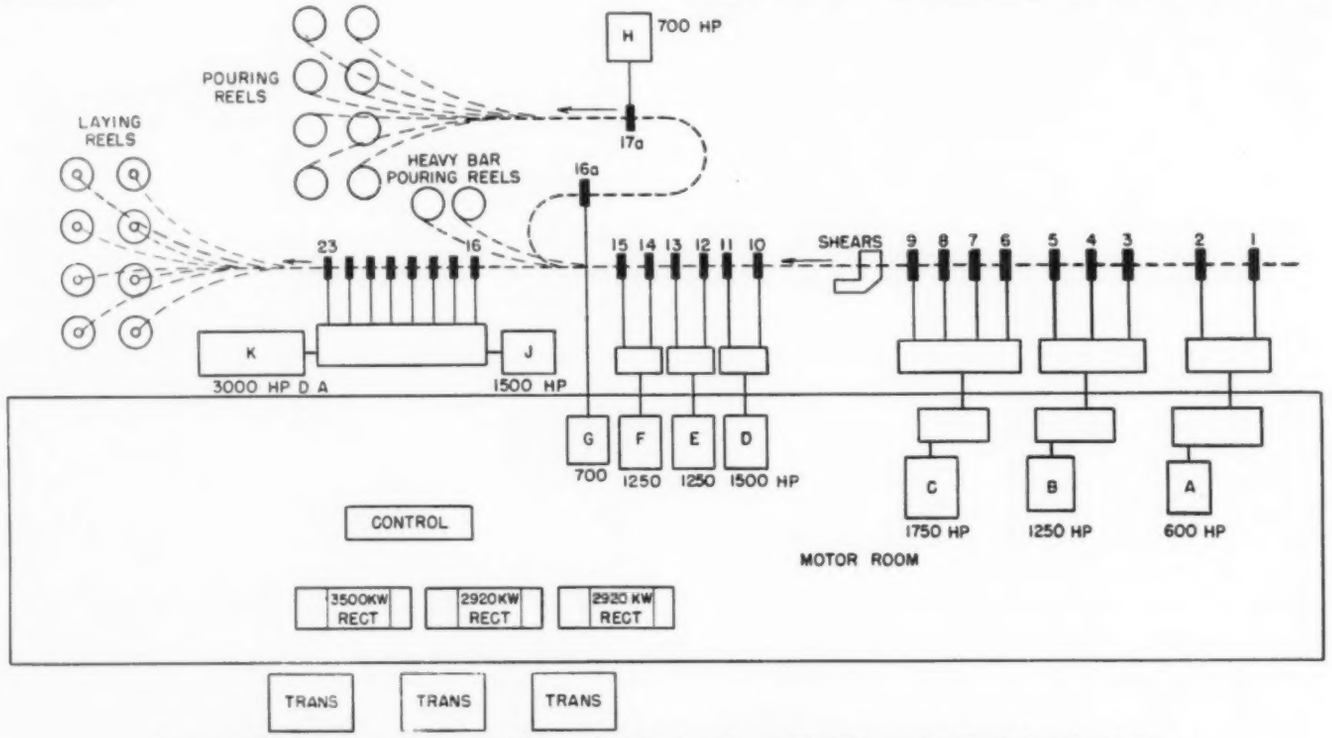
Producers of bar products have been finding that short runs, fast delivery and shipment requirements on the part of the customer have necessitated an increase in the number of roll changes or a decrease in the number of tons per run.

Titanium carbide has been applied to rod mill guides. Users of the guides made of the new material report that the yield has increased up to two per cent and savings up to $2.75 a ton are obtained due to less downtime. Service is increased in ratios up to 45 times over the life expected with the conventional materials, and guides have given up to 200 hours service per regrind. The guides have been installed on some of the new high speed mills.

material to be sheared in such a way that blooms or slabs are always cut at 90-degree angles.

Another manufacturer entered the field of shearing and welding lines, with a line capable of welding at full line speed the full range of strip thicknesses. The product thus welded can be run through the cold mill without slowing down and without failures or breaks due to the weld. A unit has been installed on a new silicon line under construction by a large steel company.

A skewed-roll cold straightening machine was put on the market, capable of cold straightening all kinds of tubing and solid bars including thin-wall non-ferrous tubes while still giving excellent surface finish. The arrangement is so set up that even though the two lower rolls are normally driven with five idling pressure rolls arranged vertically, any or all of the five upper pressure rolls can be driven if desired. The axis of the rolls are skewed around 30 degrees to the longitudinal axis of the material, giving rotation of the



Layout shows schematic arrangement of four-strand combination rod mill and motor drive.

Carpenter Steel Co. of Reading, Pa. put into operation a hot rolling mill which will produce strip, rods and bars on one combined mill layout. This mill was laid out to meet the requirements for a wide range of specialty steel products including tool, stainless and alloy steels. Monthly production of 3500 tons of specialty steels is expected. The unit also incorporates improved heating facilities that aid in controlling surface decarburization.

An unusually large shear was put into operation at the Clairton works of U. S. Steel Corp. This unit, an addition to the 40-in. blooming mill facilities, cuts hot steel slabs up to 7-in. thick and 42-in. wide. Maximum knife pressure is 2,200,000 lb and the shear has a 13-in. combined up-and-down stroke. It will make 12 cuts per minute and is powered by a 250-hp motor. A unique feature is the gag which is equipped with a stabilizer which keeps it in a vertical position relative to the material being straightened. In this way all sections of the tubing have straightening action applied to them. One set of rolls covers a wide range of sizes, and material can be handled with a ratio of maximum to minimum workpiece diameter up to 5 to 1.

Permanent magnet skelp rolls now on the market may replace the electro magnetic rolls in propelling skelp into the furnace and similar applications. The permanent magnet units are simpler in construction, and less costly in maintenance. They consist essentially of a heavy steel shaft on which are keyed two cast aluminum hubs, to which are attached the magnetic elements consisting of heavy Alnico V bar castings. These in turn are covered by the outer cylindrical steel pole rings or shoes. These units are unaffected by heat up to 700 F, so the initial roll can be installed as close as two feet from the furnace.

Another application for permanent magnets, in-

stalled on a west coast mill, is as a palm oil cleaner. Due to the added cleanliness in the oil, the mill has been producing a reduced amount of defective product. It is reported that the reduction in holes in the operations in which permanent magnets were used for cleaning palm oil have ranged up to 17 per cent.

The various shapes and forms and strengths in which permanent magnets can be fabricated lend them to many other ingenious applications in the rolling mill, particularly for material handling items on steel and tin plate classifiers.

There has been tremendous advances in the development of gages for measuring the thickness of sheet and strip, and for measuring the coatings on sheet and strip. Marked progress has been made with nuclear type gages. These are used to control the thickness of tin on tinplate and also of zinc coating from continuous galvanizing lines. One application on a continuous galvanizing line was installed by Armco Steel at Middletown, Ohio. The unit here measures the zinc coatings on both sides of the strip as it emerges from the zinc pot. The nuclear rays in the unit are a reflecting type which bounce back into the radiation detector as the gaging heads scan back and forth across the sheet. Unit automatically compensates for changing temperature, humidity and dust content of the air.

Another radio isotope measuring device is being used by a steel company in rolling sheet steel. This unit is coupled to the screw-down controls so that it automatically reads the thickness of the sheet, and then adjusts the rolls when necessary. It is reported that the uniformity and thickness of steel improved 50 per cent with this equipment.

The research work being done by the American Iron and Steel Institute at the Armour Research Foundation on substitutes for palm oil for hot dipped tinning and cold rolling has been completed. Several domestic materials were found to be satisfactory, but the most promising is apparently a specially treated low grade tallow. The availability of this material should eliminate the necessity of stockpiling palm oil. Savings from the use of this tallow may be substantial. In some cases, the power required to run cold mills is reduced.

In 1953 the steel industry used about 17,000 tons of palm oil, of which 75 per cent was used as a lubricant in cold rolling sheet and strip. The rest is used in hot dip tinning.

The heavy press program of the air force was cut back appreciably during the year. The capacity already installed is now more than sufficient and the operators are looking for private and non-military work. A number of the larger units were cancelled.

Companies still in the heavy press program are Alcoa, Harvey Machine Co., and Kaiser Aluminum and Chemical Corp. The present program includes ten forge and extrusion presses. Alcoa has a 15,000-ton forging press in operation and 8,000, 35,000 and 50,000-ton units under construction.

Allegheny Ludlum reports that it is now hot extruding a number of different cross-sections for jet engine use. Sections for other applications are also being produced. Alloy grades being made into shapes include 405, 410, 403, 430, 303C, 304, 321, 310 and a variety of tool steels. It is reported that the process is particularly adaptable for small quantity orders, eliminating lost production time for roll changes and expensive cutting of special rolls. The extrusion operation reduces the generation of scrap in many cases and also reduces machining time.

As an example of the advantages of the extrusion process, one manufacturer reports that a bracket which was formerly fabricated at a cost of $29.40 can be produced on extrusion press for $8.90.

It has also been reported that carbon steel rods have been extruded which have one or more cores made up of other materials. These cores are parallel to the axis throughout the rod and can be made in diameters down to 0.004 in.

In addition to steel, hot extrusion is also successfully producing shapes out of titanium as well as many of the alloys. The qualities of the extruded sections are equal or superior to rolled sections. Possible differences are perhaps better tensiles, ductility and toughness, but on the other hand there may be more grain size variation.

Other extrusion processes being developed will produce longitudinally tapered sections, step and multi-shouldered extrusions as well as combination die forgings and extrusion. To produce longitudinally tapered sections, split dies which can be moved laterally during the course of the extrusion are used.

Many of the steel extrusion presses being installed will use molten glass as a lubricant. A recent invention made to eliminate heat loss from the metal to the die will use a cake of an exothermic material to release heat during the extrusion process. This is supposed to eliminate excessive temperature drop as the steel goes through the die, thus eliminating increased resistance from lower temperatures. One composition which is used contains about 10 per cent sawdust, 23 per cent carbon black, 3 per cent manganese dioxide, 4 per cent linseed oil and 60 per cent flaked graphite.

A modified version of the Ugine-Sejournet tube extrusion process was announced during the year, which will make possible hot forming of cylindrical shapes in all forgeable materials. In the new version closed end dies are used instead of the open dies of the basic process. Market will be for tubular lengths up to 6 ft which

Extrusion press shown was installed at Alcoa's Lafayette works. Capacity is 14,000 tons.

require precise tolerances. Basic difference is that in the original process, the billet is forced forward through a die with a mandrel projecting through the die to give the correct internal shape. In the modified process, the billet is forced into a closed die and the ram pressure squeezes the metal back over the mandrel as the mandrel is pushed into the billet. Shells can be produced from a simple billet in one piece.

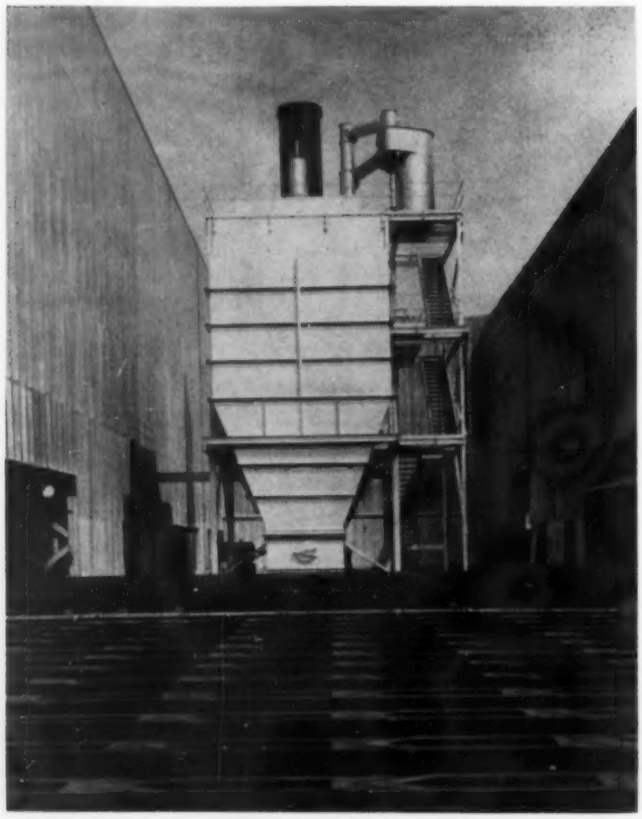
A mechanical extrusion press which has been used in Germany and Europe for some time is now available in the United States. Three such mechanical extrusion presses have been in continuous operation in Witten, Germany. These offer many features for the extrusion of various grades of stainless and high alloy steels and have also been used for aluminum and copper. Operation of these mechanical units have shown that, although glass is a satisfactory lubricant, the most satisfactory lubricant for the higher speeds of mechanical presses is a mixture of graphite oil and a separate chemical ingredient.

The mechanical press is particularly adapted for small diameter seamless tubing in practically all grades of steel. An outstanding unit is a new 2200-ton press designed to extrude a 250-lb billet. This press can thus produce all conventional pipe and tube sizes up to 2⅞-in. in 35-ft lengths, and larger diameters in shorter lengths.

FINISHING

Finishing is becoming one of the most important phases in steel production. As efforts for sales markets increase, as quality demands become more stringent, the production of steel in better finishes and in newer coatings for various purposes becomes a more important item, particularly as the percentage of steel going into consumer goods increases. These are factors behind the tremendous increase in expansion programs for tin plate, galvanized and other coated products.

Precipitator unit was installed to handle gases from scarfing machine on blooming mill at the Fairless works. Unit cleans 75,000 cfm of gas at efficiency of 95 per cent.



The trend to electrolytic tin plate is still increasing and capacity is becoming greater with hot dipped capacity being reduced or eliminated. Examples of this are the new electrolytic tin plate line at Kaiser Steel which adds 70,000 tons of capacity and the modernization program at Weirton Steel which increased capacity and operating speed of two electrolytic lines. Weirton also apparently is contemplating a new electrolytic tinning line.

In Weirton Steel's modernization program, four plating cells were added to the existing plating cells on No. 4 electrolytic line. The twenty-four 7500-ampere generators were replaced with 9000-ampere units and four new ones were added for the new plating cells. The line now consists of 28 plating cells and 28 generators of 9000 amperes each. This increase in size of the generators made it possible to run a larger percentage of the strip through the line at maximum operating speed. Heating capacity of the reflow tower was increased to correspond with the step-up in generator power.

On No. 3 line, a new plater frame was erected similar to the arangement on No. 4, and new plating cells and rolls were installed. The twenty-four 5000-ampere generators were removed from No. 3 line and they were replaced with the twenty-four 7500-ampere generators removed from No. 4 line.

The Tennessee Coal and Iron Division of U. S. Steel started construction on a third electrolytic tinning line at the Fairfield Tin Mill. This is scheduled for completion early in 1955.

The development of differentially coated tin plate is a factor in the trend to electrolytic tin plate. Most of the differentially coated products have a coating weight of 1 lb per base box on one side and 0.25 lb on the other side. Hot dipped tin plate carries about 1.25 lb per base box. As a result, when the dual coat plate is used for food products, it is not necessary to lacquer the inside as is ordinarily done with the straight electrolytic tin plate. Elimination of this lacquering opens new markets, conserves strategic tin.

As a result of this trend, Jones and Laughlin Steel Corp. converted one of their two alkaline electrolytic tin plate lines at Aliquippa to the acid-halogen process. A third line at this plant already uses the process.

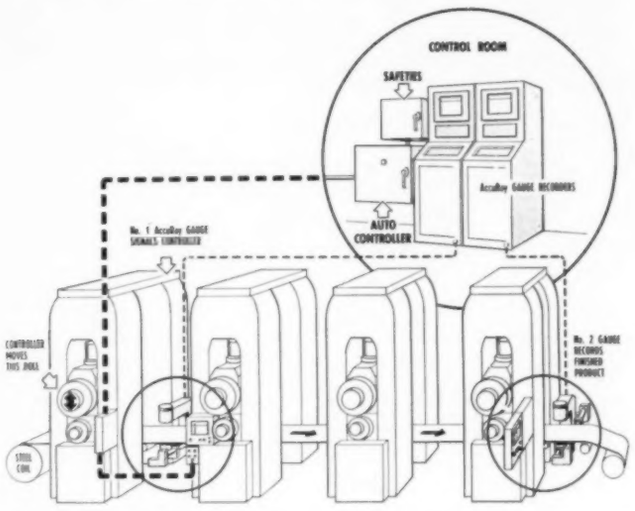
Another market is the use of electrolytic tin plate in heavy gages by the automotive industry for fabrication of products such as air cleaners, air filters and other stamped auto parts.

A method of increasing overall speed of tinplate in electrolytic tinplate lines was developed. One of the limitations in flow-brightening of tinplate has been the appearance of surface blemishes known as snow balls or quench lines. Both of these can be eliminated by precooling the strip through the use of a non-oxidizing cooler gas followed by water quenching at temperatures of 125 to 130 F.

Of interest to tin plate operators is the development of a plastic covered steel roll for use in plating lines. It is claimed that this has a number of advantages over

the rubber covered rolls most often used because of the greater resistance to the high temperatures and exposure to acids. Spots due to rubber pickup on the final tinplate are also eliminated.

The strong trend towards continuous galvanizing is shown by the 22 continuous lines in operation, exclusive of two electrolytic units, and five under construction at the end of the year. Several others are in the discussion stage. Production of galvanized sheet in 1954 totaled 2,470,000 tons compared with 2,348,687 tons in 1953. Thus, the production of galvanized sheet gained in spite of the drop in overall steel production. About 75 per cent of the galvanized output is now coming from continuous lines, nineteen per cent is hot-dipped and six per cent is coming from electrolytic lines.



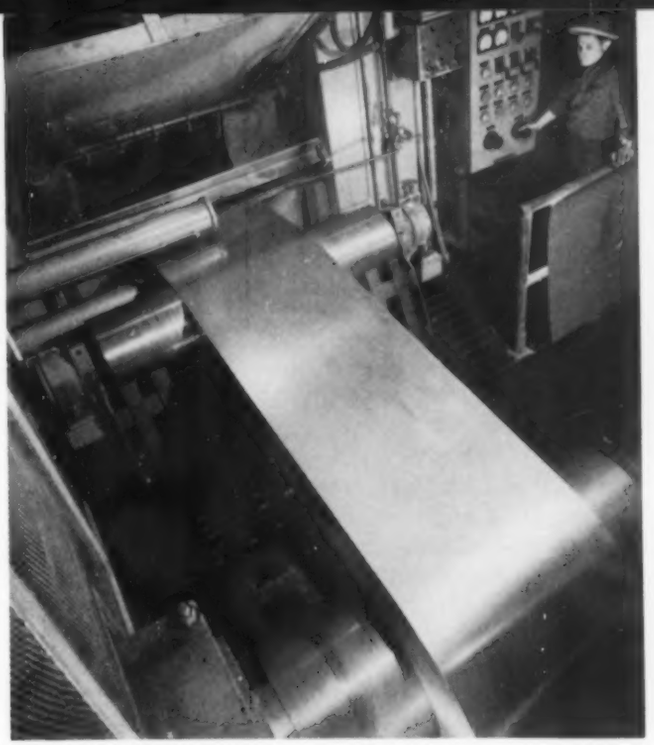
Nucleonic gages are used to control screwdown on strip mills thus giving more uniform gage.

As of the present time, Armco has six lines in operation of which two were completed in 1954. Inland Steel Company has two lines in operation with a third scheduled to go into production in the third quarter of 1955. Wheeling Steel Corp. put one line in operation in 1953, and the second unit will go into operation in 1955. Tennessee Coal and Iron started a unit early in the year, and U. S. Steel started a new line at Gary, Ind. in December.

Bethlehem Steel Co. will have a new line in operation in 1955 at Sparrows Point which will have a capacity of 84,000 tons annually. Republic Steel's new line will go into operation in the second quarter of 1955. Jones and Laughlin Steel Corp. are starting construction of a new line in 1955. Weirton Steel Co. completed one line this year and will revamp its No. 1 line in 1955. Reeves Steel and Manufacturing Co., plans to install a continuous, hot dip galvanizing line.

Two lines are also planned for plants in Japan and one for Italy.

The new No. 2 continuous galvanizing line at Weirton Steel operates at speeds up to 300 fpm. It has a capacity of 60,000 tons of galvanized steel per year, and is 710 ft long including a 254-ft continuous annealing section which heats the steel to between 1400 and 1700 F ahead of the molten zinc kettle. The line consists of pay-off reels, shear, welder, trimmer, looping pit, hot dip tank, scrubber, electrocleaner, scrubber, spray tank, dryer, looping pit, tension unit, heating



Few mills are now being installed without a continuous gage to measure thickness. An X-ray unit is here shown which records thickness at center of sheet.

zone in the annealer, holding zone, cooling zone, galvanizing pot, cooling tower, water rinse, dryer, looping pit, leveler, shear, winding reel, shear, brander, leveler and piler.

No sooner did Wheeling Steel Corp. have its continuous galvanizing line in production in November, 1953, than demand for the product necessitated the authorization of a second line, which will be located at Martins Ferry and built at an estimated cost of $4,000,000. The first line was designed to coat strip 24-36 in. wide, from 0.012 to 0.060 in. thick, at speeds of 50-300 fpm, with product in coils up to 30,000 lb and sheets 3 to 14 ft long. The new unit will be in operation by May, 1955. It will have twice the capacity of the first line, up to 50 tons per hour, will handle stock up to 48-in. wide up to a maximum 10 gage, at speeds of 50 to 200-fpm, with product either in cut lengths or coils. A unique feature of these lines is the use of electric induction heating to heat the coating metal. What is believed to be the largest electric induction heated pot for heating zinc is used The metal bath holds 175 tons of zinc metal and the induction units use 2300 kw of electric power.

On the line of Wheeling Steel at Martins Ferry, all d-c drive motors are connected to a variable voltage system which is divided between four generators. Constant torque is a basic characteristic of the line rather than constant horsepower, and a line speed range of 6 to 1 is obtained by adjusting armature voltage. Thus, it is possible to use constant speed d-c motors suitable for constant torque operation over the entire 6 to 1 range.

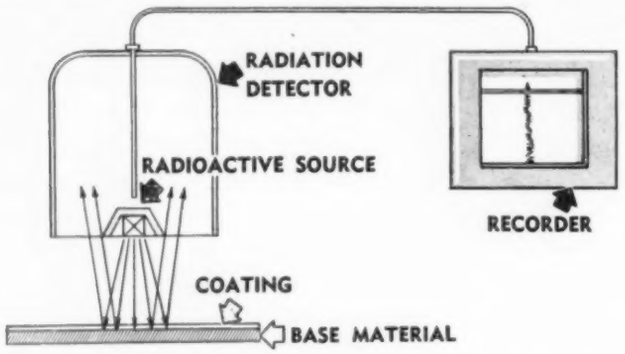
The new continuous galvanizing line at the Warren plant of Republic Steel will be similar to the Wheeling line and capable of handling a maximum width of 48-in. in light gages.

Inland Steel Co. put a second continuous galvanizing line into operation in May, and at that time retired

from service the last of its old style molten zinc pots. Construction of a third continuous line was started in December, 1954, at the Indiana Harbor Works, to be completed at the end of 1955. The new line will have a capacity of 80,000 or more tons annually. The two existing lines are producing at an annual rate in excess of 130,000 tons.

Many other refinements and coatings are being put into production. In some plants sheets are pretreated for painting to give longer life and better appearance. After applying the zinc coating to the sheet, they apply a phosphate coating which gives paint much better adherence to the final finished product.

Improvements for certain applications can be obtained by coating strip with various materials. One such operation coats strip electrolytically with a lead-tin alloy which reduces wear on dies and forming rolls by acting as a lubricant and may eliminate or reduce postfabrication plating cost. One feature is that the



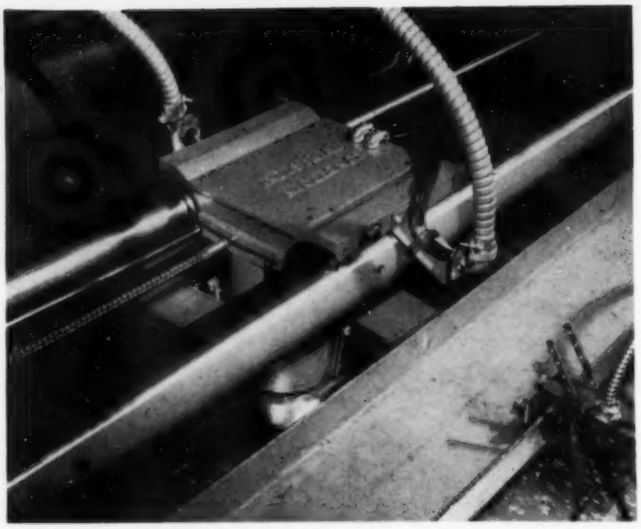
Zinc coating thickness is measured by atomic gages on Armco's new continuous galvanizing line.

material has excellent soldering properties which remain unchanged and require no flux.

Another new coating for flat products is a silicate similar to porcelain enamel which can be applied at a cost comparable to hot dip galvanizing. The coating fuses to metal at temperatures of 900 to 1200 F and can thus be applied to ferrous products without any great risk of distortion. The coating covers the surface completely, including the edges and corners. The product is a result of research by Youngstown Sheet and Tube Co. and Poor and Co., who set up a jointly owned research firm to develop it. The basic material is a special sand from northern Michigan which is smelted by Poor and Co. The coating is applied to the metal in the form of a paint-like liquid which can be dipped or sprayed. The water in the coating is then evaporated and the object fired at the specified temperature. Practically all colors and textures can be obtained in the coating. The average coating thickness is about 0.002 in.

Production on a large scale was started by one manufacturer on a new process for nickel plating, which can be applied to inexpensive base materials. The bond is intermolecular and porosity is zero even on thin coats. Its value will be primarily to the chemical, petroleum and process industries. A great deal of it has been used in nickel plated pipe.

A number of firms have also entered the market for making plastic-coated sheets, which may compete with steel, particularly in the chemical decorative and display fields. However, the entrance into the market of plastic-coated steel sheets may give the steel industry a boost for applications which are now handled by other competitive materials.



Gage head of nuclear gage on Armco's continuous galvanizing line ranges back and forth across the width of the strip, measuring coating thickness on both sides.

One application is the use of plasticized polyvinyl chloride. The vinyl can be applied to any steel, aluminum or magnesium surface, and it is also possible to bond it to other metals. These laminates maintain dimensional stability up to 250 F and will not support combustion. Material can be bent, stamped, drawn, punched, drilled, and sheared, although it cannot be welded, brazed or soldered. At the present time, costs are such that the laminates are cheaper than stainless, but more expensive than galvanized and enamel stock.

There is a definite trend to new applications of mechanical descaling, particularly by the shot blast process. The use of the process will reduce pickling requirements very markedly, and in one plant has eliminated this need. The largest installation under construction is at Empire Steel at Mansfield, Ohio. This will be a 16-wheel unit which will clean from 24 to 54-in. wide carbon steel strip at 250 fpm. Machine will handle 1000 lb of abrasive per minute, and in this case is followed by a 60-ft acid tank which acts as a secondary cleaner. Descaling costs are estimated at 46¢ per ton.

Other mechanical methods for grinding out imperfections in scale and slab, particularly in stainless and special steels, are replacing the manual methods and swing grinder practice. Rotary Electric Steel Co. in Detroit set up a grinding line with 14 grinding machines which will mechanically clean and condition slabs. On this equipment, all of the positioning mechanisms are hydraulically controlled from an operator's station. Advantages claimed are increased output, grinding wheel savings and greater safety.

Another new continuous billet and slab grinding line for grinding alloy steel products on a production basis, provides modern high speed, dust-free production units, complete with automatic feeding devices and inspection tables, as substitutes for the old swing grinders. The new line consists of an automatic billet or slab feeder, grinder approach and runout tables, and grinders complete with inspection tables that mechan-

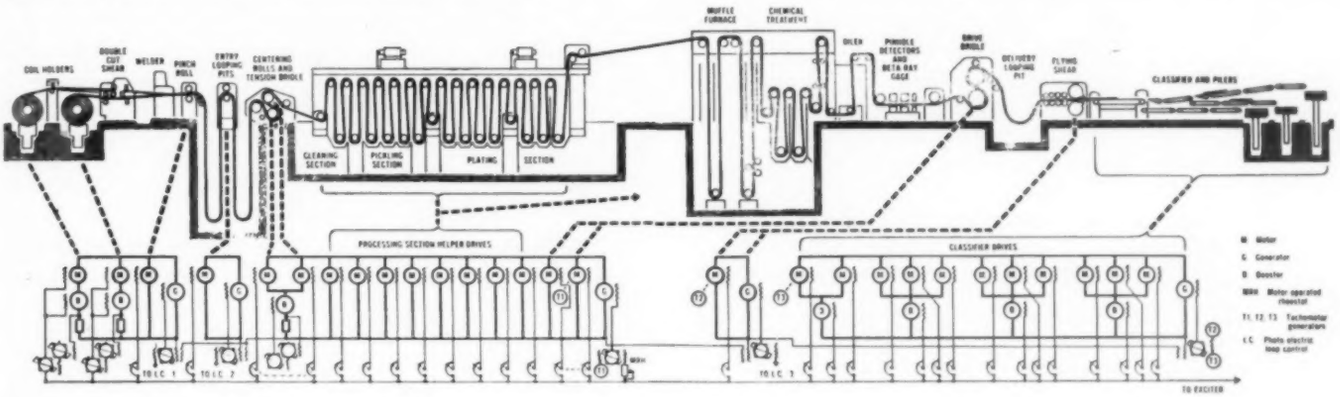
ically rotate the product through 360 degrees for the inspector and deposit the product into a two-position cradle car. All grinding is performed under water sprays.

FURNACES AND CONTROLS

A rather unusual tunnel type furnace was put into operation at Timken Roller Bearing Co.'s Canton plant. The selection of this type unit was made because of anticipated fuel efficiency and the semi-automatic nature of the unit. In this furnace, billets are moved through on cars 12 ft wide and 11 ft 9 in. long, in periods of time ranging from 45 minutes to 1 hour and 40 minutes, with the time varying with billet size. Fire resistant hydraulic fluid is used in the handling equipment and in the furnace mechanism. This company also uses a fire resistant fluid in their straddle trucks.

Phoenix Iron and Steel Co. at Phoenixville, Pa., is installing a continuous furnace for reheating seamless pipe up to 18 in. in diameter between the piercing mill and the sizing operation in the company's seamless mill. A novel feature is the use of temperature control to prevent any tube from leaving the furnace which is not the exact predetermined temperature. The unit consists of seven furnaces in line, with automatic variable speed conveyor equipment synchronized with the mill speed.

Good performance has been obtained by Armco Steel in their improved continuous batch-type furnace for annealing sheet at Ashland, Ky. This unit gives low fuel consumption, high production, flexibility, accurate temperature control and uniform product. This tunnel furnace (12-ft wide) consists of twelve insulated car bottoms each 16 ft long. After the sheets and plates are



Schematic diagram shows modern electrolytic tinning line in operation in Kaiser Steel's Fontana plant. Units shown are typical of the newer units.

The heating zones of the furnace are fired by gas through 34 burners, with oil as a standby. A discharged car from the furnace is pulled onto an exit lift by a car separator and then lowered beneath the furnace, where a dolly returns it to the charging end. Capacity of the furnace is 40 tons an hour and estimated cost was $500,000. Automatic control is applied to temperature, air-fuel ratio and furnace pressure. Round billets are automatically charged into the furnace with a tong-type automatic charging machine, one or two at a time, depending on whether single or double rows of billets are wanted. A closed circuit TV system enables the operator to view the charging.

Timken also installed a car-type furnace at their Gambrinus plant for continuous annealing of heavy walled seamless tubing. The new unit has a capacity of 3000 tons of annealed seamless tubing a month, and is gas fired with oil as an auxiliary fuel. The furnace is charged and discharged by means of a fork-lift truck. The charge is placed on 32 cars, 8 ft by 6 ft 8 in., which will move through the furnace with 22 cars in the furnace at one time.

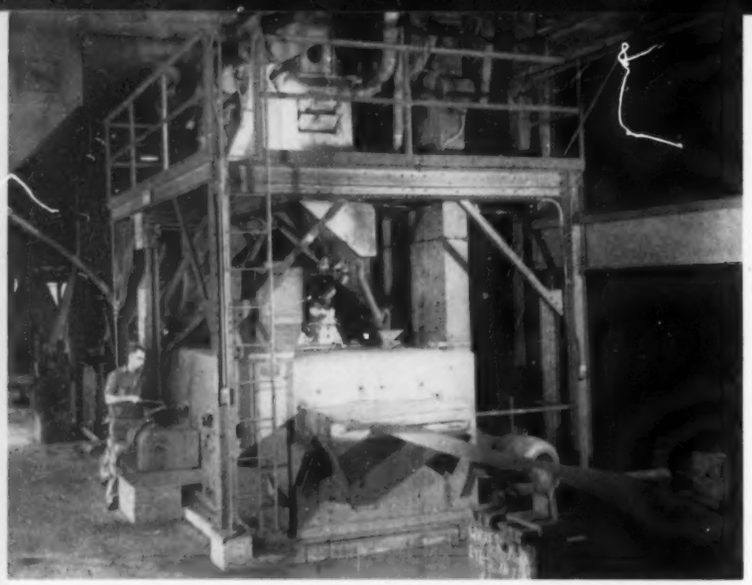
A rotary hearth slab heating furnace, installed by Alan Wood Steel Co. for their plate mill in Conshohocken, is equipped with automatic charging and unloading equipment, automatic combustion control, automatic temperature control and automatic fuel changeover to give a completely automatic installation. It is believed that this is the first application of rotary hearth furnace for heating slabs.

loaded, they are covered with a light sheet which rests on a layer of sand, thus saving the outer car edges. As the pusher on the transfer lorry pushes the loaded car into the furnace, an annealed load is discharged from the opposite end of the furnace. Control circuits are arranged in series, with thermocouples on each face and end of the charge and in the combustion space between cover and furnace wall. Thus, firing is fully controlled.

Armco Steel put into operation at their East works plant at Middletown, Ohio, a new annealing department, and added twelve new coil annealing furnaces to present capacity at a cost of $1,750,000. Units are single-stack, convector type, which will anneal 75 tons of coiled steel per charge. Monthly capacity is 12,500 tons. They will operate on thirty-six bases, allowing ample time for preparing new charges. Fuel is coke oven gas.

A continuous vertical tin plate annealing furnace for the Steel Co. of Wales will be the first such unit to be built in England. This unit will handle strip up to 38 in. wide and 0.0075 to 0.020 in. thick, with an output of 16½ tons per hour at temperatures up to 1350 F.

The United States Steel Corp. expects to have in operation at their Vandergrift plant, sometime in the latter part of 1955, new facilities for the processing of silicon steel. This will include three continuous annealing lines designed to handle strip widths of 18 to 42 in. and thicknesses of from 0.007 to 0.031 in. The annealing furnaces are designed for a nominal production capacity of 40,000 lb per hr of 0.014 in. by 30-in. strip



Mechanical descaler is being used on straight chrome stainless strip unit which eliminates scale breaking.

at 460 fpm on a stress relief cycle, and 16,000 lb per hr of 0.014 in. by 30-in. strip at 184 fpm strip speed on an anneal cycle. The furnaces will be all-electric and will operate at maximum temperatures of 1650 F on the anneal cycle. Two of the lines include a coating unit which will supply a separating medium to prevent sticking during subsequent batch annealing. Provision is made on the third line for the future addition of the coating unit if production indicates this to be necessary.

Some rather unusual salt bath units were installed by Allegheny Ludlum Steel at their Watervliet, N. Y. plant to heat stainless steel billets of various analyses at temperatures up to 2300 F. Billets heated are 5¼ and 7-in. round, varying in length from 6 to 24 in. Many of them are used in the hot extrusion press. It takes 25 minutes to heat a 5¼-in. round from room temperature to 2300 F. The furnaces consist of a 1400-kw and 900-kw unit. The use of the bath eliminates all atmosphere problems.

Weirton Steel Co. started construction in November on a continuous cleaning and annealing line as well, as tin plate warehouse facilities. The line will be designed for a maximum speed of 2000 fpm which is about double that of present units. It will handle strip in 60,000-lb coils, up to 45 in. wide.

The new line will be on the fourth floor of the building. Electrical sub-stations, hydraulic, air cleaning and neutral atmosphere equipment will be on the third floor, tin plate warehouse storage on the first and second floors. One reason for locating the line on the fourth floor is that the looping pits will go down into the structure permitting the looping of 700 to 1000 ft of strip in each pit. This increased loop length will enable running a larger percentage of the strip at the maximum operating speed of the line.

McLouth Steel ordered a large annealing installation for their new cold strip mill at Trenton, Mich. Equipment consists of 24 single-stack furnaces together with 60 bases, giving an annealing capacity of 40,000 tons a month of low carbon strip steel in widths up to 52 in. One of the unique features of the installation is an oil firing system which will use lightweight oil in a specially designed burner. The combustion characteristics will be the same as with gaseous fuels. This is accomplished by the use of recuperators which utilize waste heat from the radiant tubes to preheat the combustion air. Completion of this installation is scheduled for late Spring or early Summer 1955.

The addition of high speed, direct fired pre-heat panels to annealing furnaces, particularly in continuous strip annealing installations for carbon, stainless and silicon, have resulted in increased capacity. Accomplishments are cleaning of the strip by burning off the oil film before entering the gas atmosphere, and preheating of the strip which allows greater tonnage to be processed through the annealing furnace.

Detroit Steel installed multiple-fuel circular soaking pits designed to fire either low Btu mixed gas, coke-oven gas or No. 6 fuel oil. These pits are designed to give maximum flexibility at various rates of production, and provide high thermal release for fast heating. The use of mill scale as a dry bottom material has given many advantages.

Electric soaking pits are said to be gaining favor in European steel centers. Originally used only by Scandinavian steelmakers because of their high power consumption, they are now being adopted in some other countries essentially because of favorable operational characteristics. Such units require no recuperators or regenerators. They were made practical because of the development of heating elements which consist of carborundum troughs, filled with a resistor material, extending the entire length of the pit. The resistor material is a granular coke which is used up at a rate of 2 to 3 lb per ton of heated steel. To refill the troughs once a day is a simple procedure. Power consumption is reported at from 60 to 90 kwhr per ton.

A promising new combustion technique is the high velocity burner, specially designed to give high heat release. The design requires the solution of peculiar aerodynamic as well as thermodynamic problems. The burner offers unusual convection heat transfer possibilities. Possible steel plant applications are ladle heating, pre-heating of strip, edge heating of skelp, gas heating, and ore treatment.

The use of high pressure natural gas for the atomization of liquid fuel has been under investigation at various plants for several years. At Colorado Fuel and Iron, a specially designed double gun burner was developed for its use. The high kinetic content gives rapid mixing and produces a higher rate of flame propagation of the entire fuel input. As a result of its use on a trial furnace, production was increased from 9586 net tons in the first month to 10,373 tons. An additional increase of 700 more tons was obtained in the second month of operation. Time to produce a heat has also been reduced.

In Belgium, methane is being used for open hearth fuel. This is being extracted systematically from underground coal seams, fed to a pipe line network and used to heat open hearths, coke ovens and heating furnaces. In this operation, which is normally applied in areas that have a series of parallel coal seams, series of inclined radiating holes are driven from as many centers near the working face ahead into the next seam above the roof. These holes are capped and connected to a suction main, and the methane pumped out into useful concentration. In some Belgium plants, direct combustion of the undiluted gas from the coal seam is regular

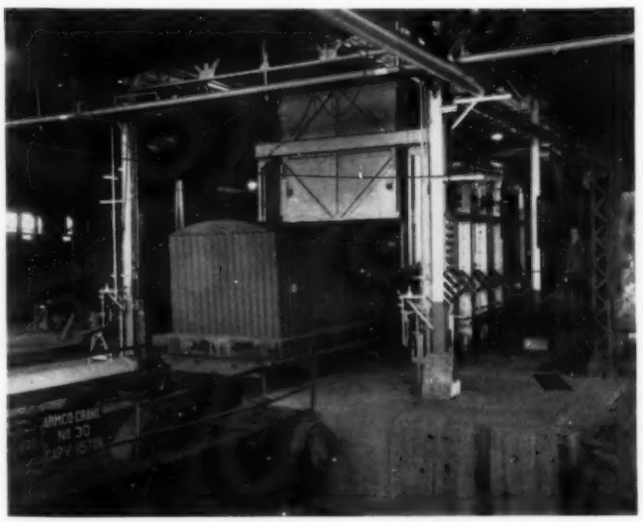
practice. The gas has a high calorific value and cannot be preheated without breaking down and depositing soot on any hot surface. Fuel oil is added in some cases to raise overall heat generation and to increase flame luminosity. Normally, there is little sulphur in the gas.

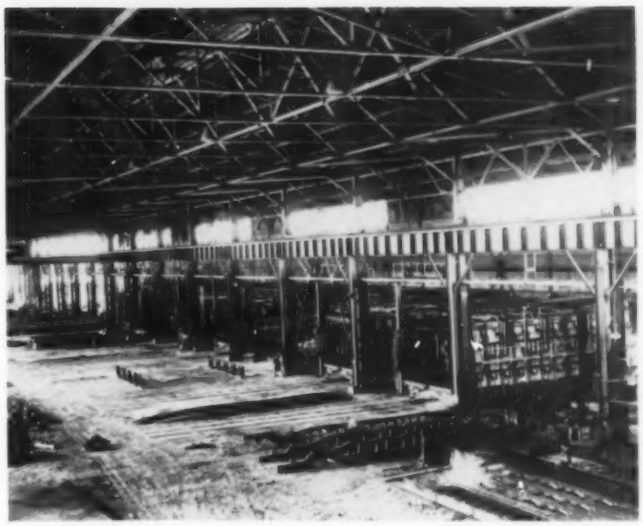
Another secondary fuel is being used by the Aluminum Co. of their aluminum reduction plant at Rockdale Works, in Milam County, Tex. Lignite is used as the energy source and this is the first aluminum plant to use lignite for fuel. At present, the plant is operating on a dried lignite, but eventually it is hoped to be able to use a lignite char which will be produced after extracting the by-products. The power plant is being operated by a utility and consists of three 80,000-kw steam-turbine generating units, two of which are already in operation.

A new device for the protection of gas fired units against failure of gas or electric supply has been developed. This unit uses a flame conductivity principle to give instantaneous cut-out after pilot flame failure. No vacuum tubes are required. A specially designed pilot burner is fitted with flame sensing electrodes which are installed as a single unit. Special fittings and adapters enable installation on most types of gas burning equipment. The burner is electrically ignited by a push button, and in automatic models, mechanically after a preset purge-time delay. The basic principle is the ability of a gas flame to conduct the electricity better than air. By placing electrodes in the pilot gas flame, a small electric current will flow across the pilot flame which ceases when the flame is extinguished. This in turn operates a relay which controls electrically operated valves in the fuel line. When the pilot is extinguished, the entire fuel supply is shut off. It does not depend upon the heat generated by the pilot for its operation.

More work on the use of 60-cycle induction heating for steel has been done during the year and applications are finding increased use in the steel industry. As a result of theoretical considerations and tests, it has been determined that round and square steel sections which are larger than 10 in. across, and slabs thicker than 7 in. can be heated with 60-cycle power with electrical efficiencies of from 70 to 80 per cent. However, heating of round sections from 3 to 10 in. across and slabs from 3 to 7 in. thick with 60-cycle power may also sometimes be economically justified. Then as the pieces become smaller, the efficiencies become lower and smaller pieces may then require higher frequencies above the critical temperatures. For this reason dual frequency units may be economically justified for many applications.

Exit end of annealing furnace at Armco Steel shows discharged box on track between furnace and transfer lorry.





Unusually large furnaces were required for plate heat treatment at Luken's new heat treatment line.

MATERIALS HANDLING

Expansion in raw material facilities and expansion in ore sources, particularly foreign sources, necessitated expansion in facilities at sea and lake ports for handling the increasing volume. A great deal of this expansion has been centered in Baltimore, Md., and Philadelphia, Pa. Much work has also been done at Mobile, Ala. Spark plugs for these programs have been the development of the ore supplies in Venezuela and Canada. However, the largest port for the handling of ore is still Cleveland, which handled 17,000,000 tons in 1953; second was Conneaut with almost 15,000,000 tons and then Ashtabula with 11,500,000 tons. In the Chicago district there are Gary with 8,800,000 tons, Indiana Harbor, with 7,600,000 tons, and South Chicago with 4,200,000 tons.

At the present time, the largest point of entry for imported ore is in Maryland in the Baltimore area. About 7,600,000 tons of iron ore were received there in 1953.

Bethlehem Steel Co., at Sparrows Point added a 1000-ft extension to its ore dock basin thus lengthening it to 2200 ft. This will improve the handling of the 7,000,000 tons of iron ore received at this plant annually.

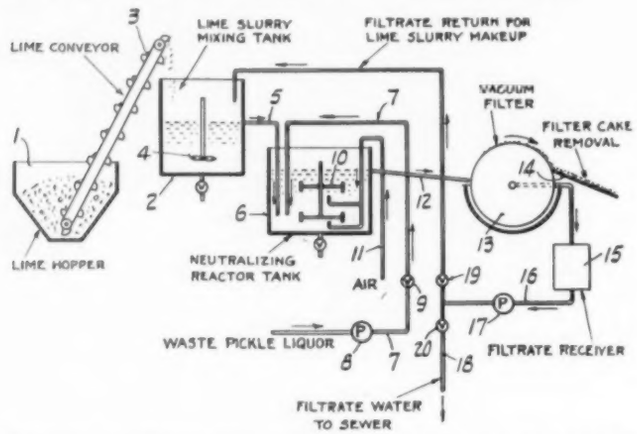
Another installation to help handle the influx of foreign ore is the Mobile ore terminal of the Tennessee Coal and Iron Division of United States Steel. The first large vessel from Venezuela was handled at this pier on August 9. From this terminal, ore is transshipped by rail or barge to the furnaces upstate.

During the year, Pittsburgh put a new public dock terminal into operation. Although a great deal of ship-

ping has gone through Pittsburgh, up to this time there has been no dock area serving the general public. This new terminal at McKees Rocks will take care of this deficiency.

United States Steel Corp. started a combined rail river and rail route from its mines in the south to its mills at Gary and South Chicago.

Detail engineering for the construction of a 110-mile coal pipeline from Cadiz, Ohio, to a power station in Cleveland was started this year. Freight savings of $1.25 per ton are expected and estimated cost is $10,000,000. Completion should be sometime in 1956.



Schematic shows one proposed solution to the pickle liquor problem.

The line would carry a slurry mixture of crushed coal and water at 8 fps in an 11¾ in. pipe, handling 1,500,000 tons of coal annually.

An ingenious device for handling hot ingots is a 35-ton carryall used by Dominion Foundries and Steel, Ltd., to handle hot ingots from the soaking pits to the rolling mill. Its use avoids reheating of the ingots because of time saving.

Alcoa is transporting ladles of molten aluminum from the furnace to the pouring station with a special 20,000-lb capacity high-lift, crucible-handling, electric straddle truck. The truck has an overall height of 154 in., and a maximum lifting hook height of 103 in. Power for the drive is provided by a diesel-electric unit.

Straddle type carriers have met with increased acceptance in the steel industry and are being used, not only for miscellaneous handling jobs around the plant, but also for production operations of various types with special pallets, etc., designed specifically for the operation.

A trend in materials handling equipment, particularly in trucks, is the new time and leasing plans being offered. These are similar to those offered by the machine tool industry which enable users to lease equipment, thus giving them more working capital and in some cases offering tax savings. Many plans are so set up that payments can be applied to purchase costs.

A piece of equipment which will help electric truck operation is a new nickel-iron battery which would give 25 per cent more power in the same space as the more conventional units.

Approval was granted during the year by the Underwriters Laboratories for the use of fork-lift trucks powered by liquified petroleum gas. Relatively minor engine changes can adapt a gasoline powered truck for the liquified petroleum gas, which is ordinarily a mixture of butane and propane.

A possible hazard from the use of gasoline powered lift trucks can be eliminated through the use of a catalytic exhaust unit which is now available. This unit oxidizes more than 95 per cent of the carbon monoxide and hydro-carbons in the engine exhaust and converts them into harmless carbon-dioxide and water vapor. The heart of the unit is a cartridge with spaced porcelain rods coated with catalytic alumina and platinum alloy.

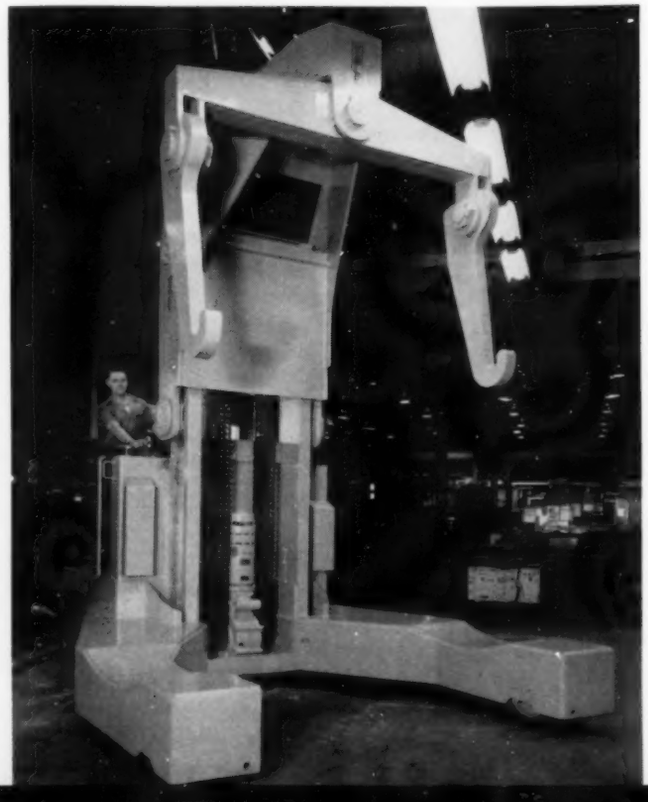
Another piece of equipment which will help truck operations is a rotating clamp attachment which enables the truck to tier material such as coils in either the vertical or horizontal position at any height within the capacity of the truck. One large steel corporation is using it to handle 15,000-lb coils.

A difficult problem in crane and ore bridge design, the design of bumpers which will stop either the trolley or the bridge safely, may have been overcome with the development of two types of hydraulic bumpers which give positive stopping action under high impact. One of these units decelerates the crane gradually in a space of six ft and the other provides a short emergency stop in two ft. Tests made on a 15-ton ore bridge with a man-trolley weighing 151,000 lb, exclusive of bucket and load, and having a maximum speed of 900 fpm, have shown that the trolley can be stopped safely.

A new crane control put on the market gives the operator 11 standard speeds for the lifting hook instead of the usual five. An added feature is that only one lever is used to control both the speed and the direction of the lifting hook.

In one steel plant, a motor drive was applied to the coil-handling tongs which closes and opens the jaws of the tong, and also provides power for turning the tongs a full 360 degrees. As a result, the plant reports faster and safer handling without coil damage. A one-hp

Unit, designed to handle ladles of molten aluminum, uses 20,000-lb capacity, high-lift, electric straddle truck.



Use of 35-ton carry-all saved sufficient time in handling ingots to eliminate a reheating.

motor provides power for the jaws, and another provides power for turning the tongs.

Some ingenious instrumentation was used by the Granite City Steel Co. to find structural defects in its ore bridge without the expensive and time-wasting job of dismantling part of the structure. Through the use of cobalt 60, a radioactive material, radiographic pictures were taken which pin-pointed the cause of sway in the structure. Movement at the connection between the top girders and the vertical members of the pier leg of the bridge had been noted by plant personnel, but the cause of the movement was hidden in the girders and plates, and could not be determined. It was not known whether the sway was caused by loose or broken rivets or broken gusset plates. In the procedure used, a capsule of cobalt 60 was suspended from a chalk line opposite the point where the movement or sway developed. Film was placed on the opposite side of the steel to get a radioactive ray picture. The film showed that certain rivets were loose, and it was a very simple matter to replace the loose ¾-in. rivets with new ⅞-in. rivets.

An unusual feature of the conveyor belts which were installed at Pennsylvania Railroad's new ore pier at Greenwich Point, Philadelphia, is that the rubber belt which is 54 in. wide is reinforced internally with high tensile steel cables.

An innovation in packaging is the use of a new supersized paper bag which will handle metal bars, pipes and extruded metals in sizes up to 14 ft long. Bags can be made in any dimension up to 74 in. in total girth and 167 in. long.

MECHANICAL

The electric power industry reached a goal in 1954 which they had been trying to make for many years. That was the production of one kwhr of electricity per pound of coal used for boiler fuel. The statistics of the Federal Power Commission hit this mark in April, and this continued through a number of subsequent months. This is a very appreciable increase in efficiency since 1945 to 1948, when the average was 1.3 lb of coal to produce a kwhr. This is a result of the large number of new high efficiency power plants put into operation by public utilities in recent months. With a continued increase in the growth of the utility industry, this efficiency figure will continue still higher.

Power plants which use steam turbines as prime movers represent about 73 per cent of the total generating capacity in this country. Among the most important trends in turbines are the development of close-coupled cross-compound turbines for large capacity installations. Other trends are the rapid increase in the size of 3600-rpm tandem machines and widespread application of reheat to improve turbine performance. Special attention is also being paid to the use of the correct size exhaust for reducing exit loss and to the development of more compact machines to eliminate building and investment costs.

Maximum steam temperatures, governed by the high temperature properties of available materials at the present time, seem to be in the neighborhood of 1100 to 1150 F. To increase pressures above the present day maximums will require going into the supercritical region because of the problems at critical pressure.

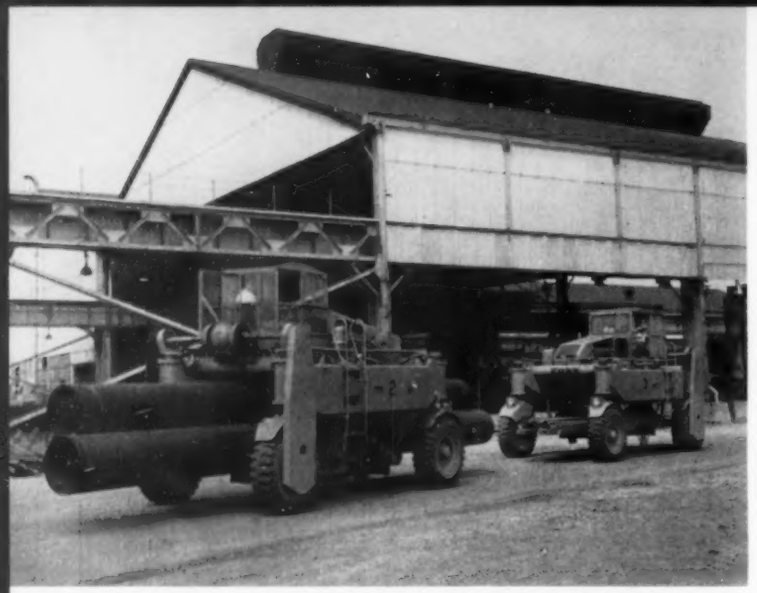
In spite of these problems, a new power plant was ordered during the year which will operate at 5000 psi and 1200 F. The unit, to be built for the Philadelphia Electric Company, will be a 275,000-kw turbine-generator unit, said to be the largest single shaft machine ever ordered. This is a big jump through the critical pressure barrier, which occurs at around 3206 psi, since the highest existing units are slightly under 2500 psi. It is estimated that the new plant will produce one kwhr for between 0.5 and 0.75 lb of coal.

A unique scheme to increase the efficiency of a power plant was used by the TVA for their new steam-electric generating plant near Kingston, Tenn., which starts full operation in 1955. At this plant, a dam has been placed across the river which goes down to within 15 ft of the river's bottom. Since the cool water is in the bottom layer, this dam skims off the warmer surface water and gives them colder water for cooling, increasing condenser efficiency.

A number of refinements in boiler equipment are on the market. One of these is the internally-finned tube, which reverses the familiar application of extended radiation from outside to the inside of the tube. Previously there has been difficulty in the fabrication, and a special process for brazing the longitudinal fins inside the tubing was developed before the item could be brought into production.

The big news in power plant development has been the acceptance of the nuclear plant as a practical reality. However, there are many possible designs and which one will eventually be adopted will not be known

Conveyor belts are being used more and more for handling of ore. Unit shown is 48 in. wide and 3600 ft long, running parallel to the ore storage yard.



Straddle trucks are being used in many steel plant material handling applications, particularly from mills to storage yards. Unit shown has load capacity of 50,000 lb.

until actual operating experience determines which gives best efficiency and best operation. It may develop that different types will have advantages in certain fields.

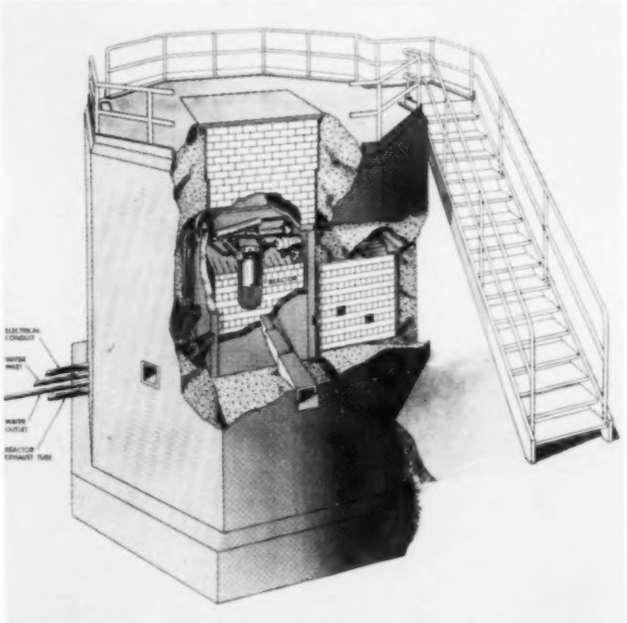
Many problems must be overcome before the first operating plant is built, so estimates of cost are quite variable. At the present time they range from $300 to $900 per kw for large plants. However, after development costs and the cost of manufacturing nuclear plant equipment have been written off, it is estimated that it may be possible to produce power at rates of from four to seven mills per kwhr in large 300,000-kw plants.

An important step was the authorization of a new 60,000-kw power plant to be built by Duquesne Light Co. of Pittsburgh at Shippingport, Pa. This will be the first large commercial unit and may be the forerunner of a revolution in power development. In addition, atomic plants are being built for two submarines, (although such units are not primarily concerned with operating costs) and a large number of reactors are either under construction or authorized for various purposes, chiefly experimental.

A big factor in the development of atomic energy is the law passed by Congress on atomic energy this year. This law will allow the Atomic Energy Commission for the first time to license private firms to build atomic reactors and furnaces, and to own and operate them. However, the fissionable fuels, which include uranium, will be leased for private use and still owned by the government.

Another important factor is that, in spite of our enormous coal reserves, there is a very definite need for new fuel supply. At the present time, demand for electric power is increasing at a rate of about 10 per cent a year, which means that the capacity must double every ten years, and the fuel must become available in about the same amount. Fortunately, estimates indicate that the heat available in the recoverable uranium supply exceeds by a number of times that from the world's fossil fuel supply.

The Atomic Energy Commission is accelerating development of atomic power by sponsoring a five-year program on general reactor research and development work at an estimated cost of $8,500,000 a year, and also a five-year civilian reactor development program which is estimated to cost about $200,000,000. In this second program, five power reactors of five different types will be built. As a result of the experience with these plants, those that look promising will be followed by larger plants. The first and largest of these units is the pressurized water reactor to be built for the Shippingport plant of Duquesne Light Co. This, a 60,000-kw unit, will be completed in 1957 at a total cost of $85,000,000, which is not an economic figure for the 60,000-kw capacity. Fuel will be slightly enriched uranium and ordinary water will be used for moderator and coolant. The highly pressurized part of the plant, that is the reactor pipes, pumps, heating containers, etc.,



Water boiler research reactor is now available for pilot plant use.

will be underground in concrete and steel, an extra precaution in the early stage of atomic knowledge. Water pressures will be 2000 psi at 525 F. Steam will go to turbine at 600 F. Above the ground, the plant is conventional. Corrosion is one of the big problems to be solved.

The second unit in this program, an experimental boiling water reactor, if successful will eliminate the problems which are present with the highly pressurized primary cooling system water, such as that in the Duquesne Light plant.

The Argonne National Laboratory is starting to build such a reactor with capacity of 5000 kw at an estimated cost of $17,000,000, including research and development. Reactors of this type should be cheaper and safer than the pressurized water unit, because the equipment required to maintain a pressure of 2000 psi will be eliminated. A problem which does come up, however, is increased maintenance because of the radioactive steam which goes through the turbine.

North American Aviation, Inc., is building a third reactor of the sodium type at an estimated cost of $10,000,000. This would eliminate the high pressure primary coolant system by the use of a liquid metal. The reactivity of sodium with air and water creates problems in the development of this unit.

A fourth project is an experimental breeder reactor unit at the Argonne National Laboratory, which will be designed for about 15,000 kw, at an estimated total cost of $40,000,000. This unit has advantages in breeding additional fuel.

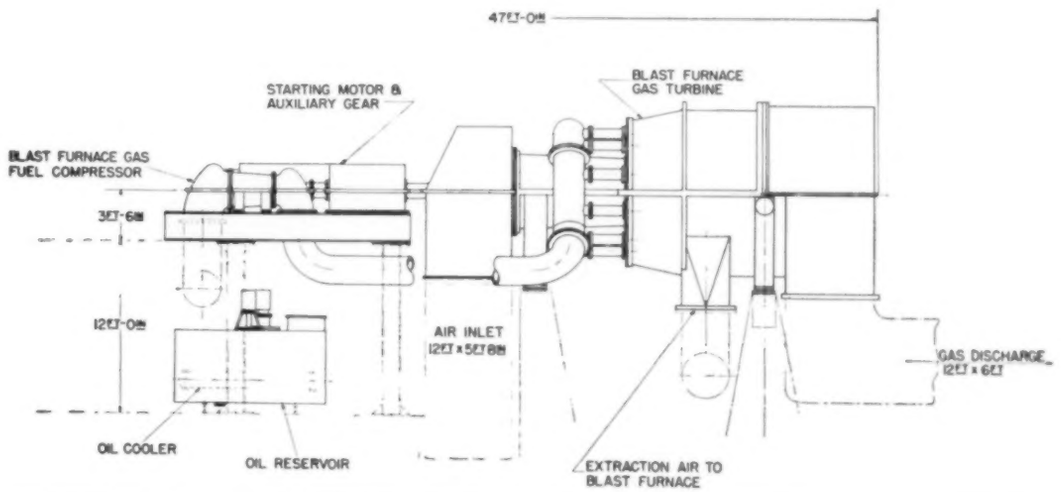
The fifth project is a homogeneous reactor being developed by the Oak Ridge Laboratory. In this unit, the fuel is distributed homogeneously in the reactor and through the entire primary heat transfer system. In other words, the fuel is in liquid form. Results are simplicity, simple chemical processing and elimination of fuel fabrication.

Disadvantages are circulation of highly radioactive fuel solution outside the reactor core and the highly corrosive nature of the fuel. The goal in the five-year program for this unit is a homogeneous thorium reactor of about 16,000 kw at a cost of $47,000,000. In this unit, thorium will be transmuted into uranium 233, a fissionable material.

ity to use an atomic reactor in its proposed new plant. The company plans to use the reactor for making steam to operate electric generating turbines, whose power will be used to supply electric furnaces. The plant is planned for 250,000 tons annual capacity primarily in sheet products. One of the units involved is a continuous galvanizing line.

At the end of year in December, Consolidated Edison Co. of New York asked for designs and price estimates for a commercial 200,000-kw generating plant which would use nuclear fuels. There is no government subsidy planned, all that is wanted is permission to buy or lease the fuel which by law only the government can own.

An application of nucleonics which may have some very important effects in the near future is the use of atomic radiation to promote chemical reactions. It is believed that high radioactive sources, because of their effect on the atoms and molecules, may speed up famil-



Sketch shows rough details of design for 125,000 cfm, 35-psig, air extraction, gas turbine power plant.

Experiments on the so-called homogeneous reactor, previously made at Oak Ridge, used a solution of uranyl sulphate in water. The water serves as a moderator and the uranyl sulphate molecule serves as the fuel elements in which a chain reaction is set up. It has the advantage of fuel fabrication, and processing is very much simplified. The solution is pumped continuously through the reactor chamber and then cooled in outside heat exchangers. Some of it can be continually let off for purification and then reintroduced into the circulating stream of combined fuel and moderator. One of the very interesting features is that it is self-regulating. As the temperature of the reactor rise, its reactivity decreases and therefore it controls itself. One of the difficulties is that the water has a tendency to dissociate. Although this does occur, it has been found possible to recombine the hydrogen and oxygen to form water without too much difficulty.

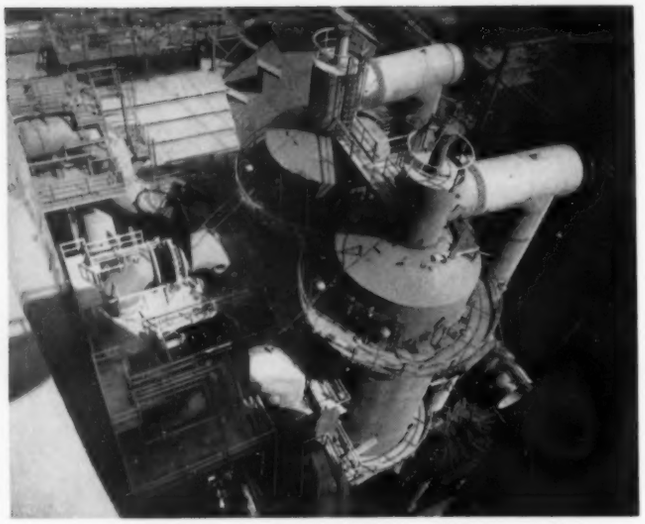
At the end of the year several low cost reactors were available primarily to train personnel for the nuclear power industry and for conducting basic nuclear research and development. These are modified versions of the classified water boiler and swimming pool reactors.

A possible early industrial use of atomic power may be in steelmaking. The World Steel Corp. of Chicago applied to the Atomic Energy Commission for authoriar reactions, start unknown ones and form compounds that have never been able to be made before. As an example, in oil refining it is thought that the gamma rays may do the job which at present must be done at high pressures and high temperatures with catalysts in such operations as catalytic cracking. It is also believed that radioactive materials may cause polymerization.

Other units have been developed during the year in which principles of atomic energy are used to determine liquid levels, to measure minute variations in thickness throughout pieces of sheet steel and to determine the existance and degree of flaws in welds.

At the beginning of the year, an atomic battery was demonstrated, which for the first time, converted atomic energy directly into electric energy.

A whole new technique of handling and operating is required when dealing with atomics. Procedures, particularly in the case of accidents, must be modified when the danger of radiation is present. To be taken into account is the knowledge that about 500 roentgens is a fatal dose of radiation. About 0.3 roentgen per week is permissible for life-long exposures. In case of accidents, contaminated spots may average as high as 10 roentgens per hr and may run up to local peaks of 3,000 roentgens. Under such conditions, it is necessary to dilute the radiation which can sometimes be done through the use of water, by insulation or by working



Twin blast furnace gas washer shown here was put into operation at the Edgar Thomson works at United States Steel.

extremely short periods of time. Elaborate protective clothing and respirators may also be required.

Gas turbines have found increased acceptance as power plants and one company has put one hundred units in service. Forty are used for natural gas pipeline pumping, twenty-seven are used in locomotives, ten are maintaining pressure in oil fields, and seventeen are being used for electric power generation by utility companies and three others are being used to generate power at industrial plants.

The gas turbine has several advantages, inasmuch as it can do three jobs. In addition to supplying power it can supply compressed air taken from its compressor, and it can supply heated exhaust gas. The heated exhaust gas can be used to make process steam or for preheating combustion air.

A report was issued during the year on research work carried on by United States Steel on the use of gas turbines powered by blast furnace gas. These tests show that blast furnace gas can be successfully burnt in high heat release gas turbine combustors with high efficiency. Flame stability, ignition characteristics and dual-fuel nozzle details were established.

Gas turbine plants can be made suitable for use with blast furnace gas fuel by modification of the combustors, addition of blast furnace gas compressors and a necessary adjustment of aerodynamic flow paths. Tests indicate that for large integrated plants, there is little advantage in planning for power generation by means of gas turbines in the large 30,000 and 60,000-kw sizes, but small isolated plants with requirements of 5000 to 15,000 kw may be served by such units.

However a very attractive application of gas turbine in the steel plant is for operating blowers for furnishing air to blast furnaces. Design of one such unit has been ordered. This will be an air extraction gas turbine with a continuous rating of 125,000 cfm at 35 psig. In this unit, atmospheric air is taken in by a 17-stage, axial-flow compressor and compressed to 35 psig. This compressor supplies air for both the turbine and the blast furnace. Blast furnace gas is admitted and burned in ten combustors to increase the gas temperature to approximately 1350 F. The hot gas expands through the three-stage gas turbine which converts the heat energy into mechanical energy to drive the actual gas furnace gas compresssor and axial air compressor.

The gas turbine is also being considered for naval use. Two companies have U. S. Navy contracts on adapting the engine for use on ships and a 6000-hp engine will soon be on trial. Advantages are, of course, that the machinery weight is cut down and so is the space. One advantage which ships can have over other applications is that the ship may be equipped with variable pitch propellers and thus overcome the one-speed handicap of the turbine.

Test units are also in operation on trucks and buses. One automotive unit has succeeded in obtaining fuel economy and overcome the high temperature exhaust problem. In this unit, heat exchangers are installed to recover heat which would normally go out in the exhaust, and this recovery in turn provides fuel economy comparable to automobiles now in use. Before such units will be in production on cars, however, a number of very complex metallurgical and manufacturing problems must still be overcome.

Many new developments are being shown in machine tools. For machining very hard parts, a process which uses high frequency sound waves to make accurate complex recesses and cavities in materials such as tungsten tool steel, carbides, glass, etc, appears feasible. In this process, an ultrasonic machine tool hammers tiny abrasive particles against the material with enormous force, obtained through the vibration of a blunt tool at frequencies of about 30,000 cycles per second.

A process of machining by etching may give greater design flexibility in some applications. Process has been developed to replace expensive aluminum skin milling and offers possibilities for steel and titanium. In the process, the forgings or extrusions are placed in a modified hot alkaline solution which etches away the surface at a uniform rate. The areas in which no metal removal is desired are masked. Differential removal is obtained by stripping masks intermittently or by gradually immersing or removing the metal from the etching bath. The process has a number of advantages in that it can be done after forming; it is not subject to restrictions on the shape and direction of the cut; it can be applied to complex sections. Originally the process could be used only to a depth of 0.5 in. It is now possible to cut deeper than 2 in.

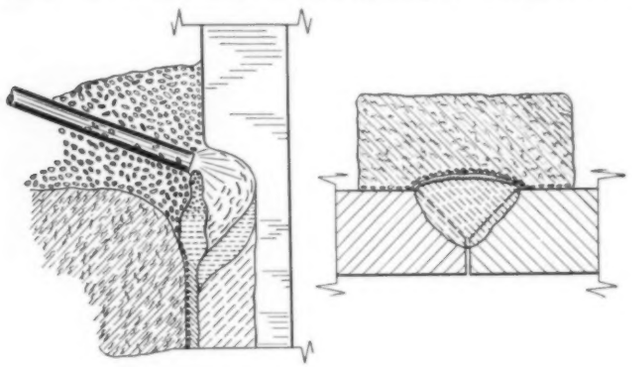
Cutting speeds are increasing and present work indicates that it may not be too long before steel may be cut in speeds up to 3000 surface fpm. At present, speeds up to 1200 sfpm are being used in actual production. These new ranges are, however, limited to carbide-tooling. Also, they are practical only in operations where the setup time is relatively small compared with the actual cutting time. Under such high speed machining, cooling is very important. Usually, water soluble oils are recommended.

A trend in lubrication is continuous spraying of heavy grease on roll necks. Where they can be applied, more and more automatic units are being installed, eliminating manual means of lubrication application.

Another proposed solution to the railroad journal box problem was offered during the year. The new unit

is a redesigned journal box which has a special design seal at the back consisting of two lips of synthetic rubber, one of which holds the oil in, the other keeping water and dust out. No waste packing is used; instead, an oil conveyor is used made up of six small nylon wheels operating against each other, turning in a reservoir of oil. These wheels are joined by a rubber loop which picks up the oil and throws out a fine spray, drenching the interior of the journal box. The units can be installed on existing cars with only minor modifications.

A new non-flammable fluid of the aqueous type has found uses in many steel plant applications. Advantages are that it is fire resistant, non-toxic, not harmful to packings and high in lubricity value. However, care must be used in introducing these materials in a system. It is advisable that, where units such as pumps are included, the pump designs and packings be checked to make sure that no trouble may be encountered.



The submerged-arc weld method has now been adapted for welding vertical joints.

These systems may have to be drained and cleaned because the fluids are by their nature excellent cleaning agents and may pick up remaining contaminants.

Typical uses are furnace combustion controls, controls on doors, presses, coke ovens, furnace tilters, loaders and ingot carriers.

Many developments in welding met the test of trial and service. One which has definite advantages is the use of heavily coated electrodes with large quantities of powdered iron in their coatings.

Since the average electrode has excess heat over that needed to melt the parent metal and rod, the current normally has to be cut back to eliminate spatter. The addition of the powder coating takes up the additional heat, gives additional filler metal and thus increases the welding speed. With higher welding speeds, welding costs and cleaning costs are reduced because of less spatter in undercut.

Another welding development makes possible automatic vertical welding in the field with a variation of the submerged arc welding process which has been primarily limited to the flat position. Special equipment recently developed makes the general method applicable for welding vertical girth joints. This is of value in field erection. The new method might be more closely described as a compressed-arc method.

A manually applied semi-automatic welding process which deposits electrode metals at a rate of 10 to 40 or more lb per hour was put on the market. The electrode is tubular in construction and contains a flux within the cavity of the tube. As the metal part of the electrode is melted by the arc, the flux core also melts and becomes a refining and shielding blanket of slag over the molten metal. In addition, a separate gas goes through the granular tube which prevents oxidation of the electrode materials while going through the arc.

Another semi-automatic machine put on test this year combines advantages of hand welding and automatic welding and eliminates most disadvantages encountered with either method. In the unit, bare wire is fed through a hand-held hopper containing a magnetic flux which clings to the wire as it leaves the hopper. The electrode wire thus reaches the arc with a flux covering that contributes to the advantages of the manual electrode coating. As a result, the operator can weld steadily for long periods of time, without delay due to replacing electrodes and without waste of stub ends. Another advantage is that it is not necessary to cover the weld area with a loose granular flux, and it is thus possible to observe the work and to eliminate the mechanical traversing or reversing which is necessary for proper deposition in many of the automatic systems. It can easily be connected to conventional a-c and d-c machines.

A tool resembling a pair of pliers was developed which makes it possible for anyone to weld by a cold process. By putting the two pieces to be welded together, such as two pieces of wire, it is possible to get very dependable welds. Primary use will be to splice copper and aluminum wire.

Continuing progress is being made on the problems of stream and air pollution. As an example, the sixth annual report of the Ohio River Valley Sanitation Commission reveals that, in 1954 alone, the percentage increase in population served by treatment works was as large as that secured during the entire eight years prior to the compact.

An extensive sampling and analysis program for the Ohio Valley Water Commission has been started by steel companies along the Monongahela and upper Ohio rivers. This analysis will give information on the rates of natural reduction of phenol concentrations under varying conditions of temperature and stream flows.

Significant installations for the control of industrial wastes in the Ohio river include one at Follansbee, W. Va., where the Koppers Co. completed a phenol-waste treatment and recovery plant capable of removing 99 per cent of the phenol formerly discharged in a tar-process effluent. The plant incorporates two unique features, one relating to tray-tower design and the other to the use of a new solvent.

Spang-Chalfant plant of the National Supply Co. put into operation at Ambridge a waste-water separation plant for the removal of mill scale, oil and grease. The unit includes primary clarifiers, secondary separators and a system of lagoons to handle 10,000,000 gallons per day, which includes the present 5,000,000 gallons per day waste load plus future expansion.

At Aliquippa, the Jones and Laughlin Steel Corp. finished an $800,000 treatment facility for the recovery of some 15 tons daily of flue dust formerly discharged into the river. Under construction at this plant and

also at the Pittsburgh plant are acid-waste treatment facilities estimated to cost $1,500,000.

Crucible Steel Co. put into operation in Midland a treatment plant for the recovery on some 120 tons daily of flue dust from its blast furnaces. This is the second stage of this company's pollution abatement program. The company put in operation a dephenolizing unit three years ago. Cost of the program is $525,000.

Weirton Steel Co. at Weirton, W. Va., is constructing a flue dust recovery plant which will remove some 120 tons daily of solids.

The Green River Steel Corp., at Owensboro, Ky., started operations on its waste-control facilities which include complete treatment of sewage, scale removal and neutralization of pickle-liquor with storage in a lagoon.

In the everlasting attempt to find the solution to the pickle liquor problem a new method was announced during the year. It is claimed that the system is simpler, more compact and more economical to operate than present ones. Operating costs run from 1.8 to 2.0¢ per gal of waste liquor depending on the strength of the acid and the cost of a neutralizing agent. One important feature is that sludge lagoons are eliminated and the effluent is acceptable to natural streams and sewers.

In the process a waste acid holding tank receives the pickle liquor, which is then fed to a reactor tank which holds it for a designed retention period. Milk of lime is fed at a steady rate to the reactor and there is high speed agitation of the slurry. The addition of compressed air increases the oxidation rate of the ferrous salts to the more easily filtered ferric state. A conductance meter regulates the degree of neutralization. This in turn controls a motor valve on the acid line to keep a constant pH. The slurry is dewatered on a disc filter and the solids can be trucked away. The final filtrate has a pH of 7.5 with no suspended solids. Of this, 80 per cent is returned to the lime slaker and the remainder is run off into sewers and natural streams.

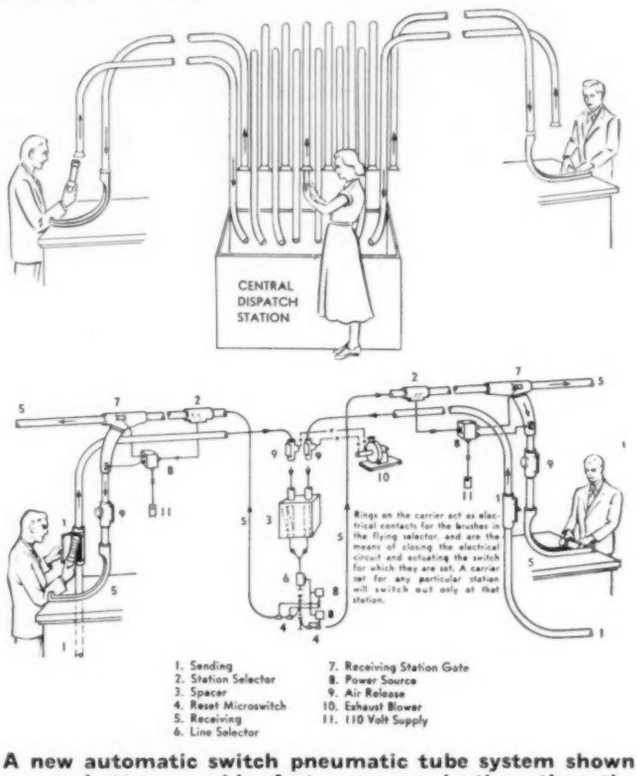
A newcomer in the family of materials is a plastic steel composed of 20 per cent cold-setting resinous binder and 80 per cent steel powder aggregate plus a special hardening agent. While in the paste form it can be molded like putty, stiffening in an hour, and hardening in two hours without shrinkage. In fluid form it can be cast and will bond to wood, metal and even glass. So formed it can be sawed, drilled, threaded and machined like steel. It has tensile strength of 10,000 psi and offers many economies in such applications as dies.

Powdered metals are giving castings competition, as the price of domestic iron powder is now down to about 9½¢ a lb as against 13¢ before the war. However, the elimination of machining and waste which is necessary on cast iron more than makes up for the cost differential on some jobs. New applications are particularly important in the high temperature field where alloys can be compounded to resist high temperatures more easily than in casting. In addition, tensile strength has been increased more than 50 per cent over that available before the war.

The research department of a large company announced the development of perfect crystals of pure iron. These are one hundred times stronger than any known metallic crystal and resistant to rust. For the first time, the crystals are as strong as theory predicts they should be. So far, no practical use has been determined.

A product developed during the year may prove to be a boon to engineers because it can detect warm objects at very long distances. It consists of a tiny piece of glass coated with lead sulphide with cells extremely sensitive to heat or certain infrared rays.

A newly developed X-ray microscope will not only look inside items such as castings, but it will magnify up to 1500 diameters, thus permitting the study of grain growth, etc.


CENTRAL
DISPATCH
STATION
Rings on the carrier act as electrical contacts for the brushes in the flying selector, and are the means of closing the electrical circuit and actuating the switch for which they are set. A carrier set for any particular station will switch out only at that station.
1. Sending
2. Station Selector
3. Spacer
4. Reset Microswitch
5. Receiving
6. Line Selector
7. Receiving Station Gate
8. Power Source
9. Air Release
10. Exhaust Blower
11. 110 Volt Supply

A new automatic switch pneumatic tube system shown on bottom provides faster communications than the central station type shown on the top of the illustration.

High speed motion picture cameras are being used more and more as a tool in investigating industrial processes. Such cameras run at speeds up to 3500 frames per second and have been used for spotting defective mandrels on tube-piercing mills and in experimental work on flat rolling mills. They have also been used in studies of impact tests and blast furnace combustion. An interesting item which they have shown is that the solid column of hot molten metal in an open hearth tap carries air into the ladle.

Communications in steel plants are being speeded up by the installation of automatic tube systems. As an example, one steel plant in Ohio installed a unit which will move a tube almost 1200 feet in one minute. This is one of the first fully automatic systems to be installed in the United States. One of the major features in the new system is that it is simply a large circle or loop. Thus, messages are sent from one station to another directly without passing through a central dispatching desk.

Another pneumatic tube system in a major plant in eastern Pennsylvania has been estimated to save about $24,000 a year in handling bulk mail distribution and interoffice communications. Three systems are used in this plant, one primarily handling bulk mail; another, interoffice communications; and a third primarily carrying samples from producing units to laboratories.

The use of linear programming is finding increased use in a number of metalworking plants. Normally, such programming is a tedious and time-consuming job which requires large-scale computors and very highly trained operators. Its application in general is to plants where a large number of operations may be required due to a multiplicity of numerous small orders. Selection of the best method of programming the work will result in marked economies and better scheduling. As an example, one tube mill was able to get 15 per cent more production out of its machines. In another plant, such programming saved an estimated $350,000 a year.

A new possibility for handling spares made from machine parts enables the telegraphing of spare parts all over the world. Essentially, the principle is that of setting up a machine operation on a tape. If this pattern information can then be put on a teletype tape, it can be telegraphed to any place in the world. In operating the system, if a certain piece of machinery broke down, the plant would wire the machinery supplier for a spare parts tape which would be kept on file by the supplier. The supplier in turn would teletype the tape to the user who would put it on his machine tool and the piece would be cut out on the tool. The actual operator might not even know what he was going to make.

A development which may be of value in the steel industry is a memory device which can be used to control units for such processing operations as continuous gaging. The equipment stores meter readings of varying magnitude and reproduces that information at a later period in the process. This is synchronized with the speed or movement of the processing line. An example of the use of the unit is in the control of a process where steel strip of varying thickness is being formed into tubing by seam welding. Since the welding current must be varied with the thickness of the strip, if the current were held constant as the material became thicker, a bad weld would result. Since it is impractical to measure the thickness of the material at the point of welding, this is done before forming it into a tube. The synchronizer conveys the information on thickness between the point of measurement and the point of welding and holds this information until it is needed to control the welding current. Another application is in gaging the thickness of coatings.

In an application of permanent magnets, a magnetic separator has added control elements so that when the magnetic element has accumulated a preset amount of tramp iron, the accumulation closes or opens an electrical contact. This operates a signaling device which will either call the attention of the operator to the condition or it can be set up to shut down associated electrical equipment.

To make steel plants a safer place to work, new safety clothing has been developed which is made up of a metallic aluminum bonded to a light asbestos cloth. These garments shed spatter and are highly reflective. The garments weigh half as much as the ones they replace, making it much easier to get the men to wear the material. In addition, instead of absorbing heat, the aluminum reflects most of the heat. As a result, in several plants which adopted the clothing, burns have been reduced, primarily because the previous burns occurred usually when the men did not wear the equipment they had at their disposal.

Elaborate electrical control must be installed to control the tremendous power being built into the new rolling mills.

ELECTRICAL

Power production in 1954 was about 545,500,000,000 kwhr of which 471,000,000,000 kwhr was by utilities, 73,000,000,000 kwhr by industry, and 1,500,000,000 kwhr was imported. Generating capacity of utilities increased 10,500,000 kw at a cost of $2,800,000,000 at the end of 1954. Scheduled to be added by utilities in 1955 are 13,000,000 kw, with another 13,000,000 kw scheduled for later. Of the present utility capacity of 102,000,000 kw, 78,600,000 kw are private and 23,400,000 kw are public power capacity. Included in the latter figure are 13,600,000 kw of federal, 9,100,000 kw of municipal and local, and 700,000 kw of cooperative. In addition to utility capacity, industrial plants and railroads have a capacity of over 15,000,000 kw. The trend is still to fuel-powered generating capacity, primarily because of lack of available hydrogenerating locations. Only about 22 per cent of the total power generated in 1954 came from hydro units.

Although the percentage of power privately generated by industry relative to that purchased from utilities is dropping steadily, the actual generating plant capacity of all industry has risen from 12,750,000 kw in 1946 to over 15,000,000 kw in 1953.

The electric utility and steel industries are rather interdependent. The electrical industry requires about 6 per cent of all the steel this country produces, while the steel industry in turn uses more than 7 per cent of the power produced by electric utilities, which is also about one-half the power used by all industry. The steel industry is depending more and more upon the utilities for their power generation. As late as 1939, with consumption of about 11,000,000,000 kwhr, half was gener-

ated by the steel industry's own facilities. In 1952, with consumption up to 26,000,000,000 kwhr, only one-third was generated by the steel industry.

The new ore processes will add to industry's power requirements, as the processes require about 85 kwhr for every ton of concentrate.

Other programs in the steel industry will also increase electrical requirements. These include replacement of old mills, replacement of steam drives, increased electric furnace capacity, more finished steel products, electrolytic plating, continuous annealing and induction heating. It is estimated that 261 kwhr are needed to produce a ton of steel.

Electrical equipment for the new semi-continuous hot strip mill at McLouth consists of a reversing rougher powered by a 6000-hp, 100-rpm, 600-volt, twin drive motor. The edger rolls are driven by two 250/650-hp, 375/1050-rpm, 230/600-volt d-c motors. A synchronous motor-generator set, consisting of four 1750-kw and one 1250-kw generators, driven by a 9000-hp motor, supplies power to the roughing mill drives. The 6000-hp mill motor and the 1750-kw generators will duplicate and be interchangeable with the mill motor and d-c generators on an existing reversing blooming and slabbing mill. Three of the four generators are sufficient to supply the full load current to the mill motor. The fourth unit is being built up primarily from existing spares and in the event of trouble will allow resumption of operations with a minimum of delay.

The five finishing stands are powered by five pumpless rectifier unit substations and one existing motor-generator set. Four of the rectifiers are rated 4000 kw, 750 volts, and one is rated 2800 kw, 750 volts. The present motor-generator set is rated 4000 kw, 600 volts. The motor ratings for stands No. 1 through 6 are 5000 hp, 125/300 rpm geared (an existing unit); 5000 hp, 175/350 rpm geared; 5000 hp, 90/180 rpm, direct connected; 5000 hp, 125/250 rpm, direct connected; 5000 hp, 150/300 rpm, direct connected; 3500 hp, 175/350 rpm, direct connected.

This mill is the second in the country to use individual power supply for each stand, and first mill to use individual rectifier power supply. The mill is one of the highest as far as hp and speed are concerned. Other electrical features are individual voltage adjustment between stands and motor field regulators to provide improved speed of response and precise control.

The new four-stand tandem cold mill at McLouth Steel will have 19,700 hp. Strip to be rolled will mostly be 58 in. wide, entering at 0.120 in. and leaving at 0.030 in. thickness. Top delivery speed for this mill will be about 3300 fpm. Mill control will use 360-cycle static magnetic amplifier regulators. Speed of response will run from 0.1 to 0.2 second or less than the one-fourth second normal with the previous rotating regulator designs.

Weirton Steel's modernized hot strip mill will have a total hp rating of main drive motors exceeding that of any other mill. Existing hp of 23,000, goes to 31,000 when the program is complete. Finishing stand ratings are: the scale breaker 500 hp, 160/560 rpm; stand No. 1, 4000 hp, 200/400 rpm; stand No. 2, 5000 hp, 200/400 rpm; stands No. 3, 4, 5 and 6, 5500 hp, 175/350 rpm. The 5500-hp drives will be made up of the existing 3500-hp motors plus new 2000-hp motors. The existing

Completely static stand and tension reel regulators are now being applied to strip mills. Most of these units use 400 and 360-cycle magnetic regulating systems.

3500-hp motors will have armatures refitted with new shafts to transmit an additional 2000 hp, and the 2000-hp motors will be coupled to the 3500-hp machines which will remain on their present foundations.

Power supply is being changed from a common bus to a separate supply for each stand, and the system will operate at 600 volts. There will be one generator and one rectifier per stand, and four pumpless rectifier unit substations will be added. Stands may be operated at different voltage levels, and motor field current regulators will be provided to give improved speed of response and vernier control of finishing stand motor speed.

The two hot mills have features which up to now have been considered standard on cold strip mills.

The new four-stand tandem cold strip mill at Pittsburgh Steel, put in operation last summer, has a finishing speed of 3100 fpm. Among the features on the mill are a 400-cycle magnetic amplifier control system for the stand and reel drives, indicating tensiometers between the stands, twin motors for each stand, an x-ray thickness gage at the delivery end of the mill, and a continuously recording thickness indicator. Individual motors are used to drive upper and lower work rolls. This eliminates the pinion stand requirement and allows greater tolerance on the work roll diameters. A 400-cycle magnetic amplifier control system is used because of greater accuracy obtained with the higher frequency. Each stand is supplied by its own d-c generator and, for proper speed relationships, the voltages of the various generators are kept equal or proportional under all conditions of operating, threading, acceleration, deceleration and full voltage steady state operation.

The new tandem cold strip mill of Youngstown Sheet and Tube Co. which was put in operation last spring at Indiana Harbor utilizes a complete 400-cycle magnetic amplifier regulating system on one stand. This stand also has the typical rotating regulator control, which is also used on all the other stands. However, it is possible to switch from the one control to the other at will. Control was installed in this manner in order to make a comparison of the rolling characteristics of the two systems on the same mill and drive equipment. Drive equipment consists of 19,450 hp in the main motors, and two synchronous motor-generator sets each rated 11,200 hp. The mill is designed to roll either sheet or tinplate gages with a maximum width of 56 in. at a top delivery speed of 3500 fpm.

The Alan Wood Steel Co. put a four-stand tandem cold reduction mill into operation late in 1954. This unit is also controlled through 400-cycle magnetic amplifiers. The mill, a 12-in. and 33-in. × 32-in. unit, will have a total of 6150 hp on the four stands and reel drives. Each of the four stands is driven through a pinion stand. Speed of the strip from the last stand will go up to about 2300 fpm. Each motor of the mill has its own individual generator with its own amplifier control. Response of the system is less than 0.1 second.

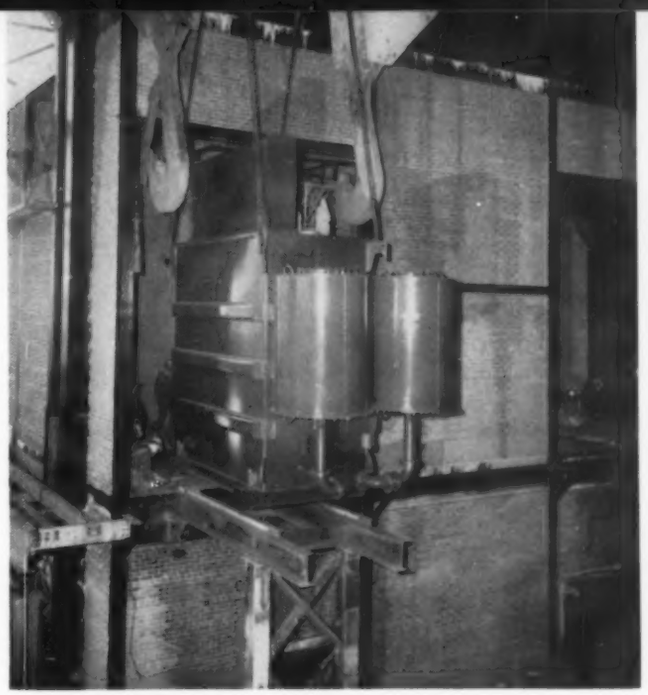
Alan Wood Steel is also installing a two-stand, two-high, 22 × 33-in. temper mill with a top speed of about 2200 fpm. This mill is driven through a combination gear and pinion stand. Counter-emf current regulating magnetic amplifiers will control the reels, thus providing constant tension and compensating for change in coil diameter during rolling.

Allegheny Ludlum Steel Corp.'s four-stand tandem cold mill is designed to produce 48-in. wide coils of cold rolled electrical and stainless steel. The mill has a capacity of 300,000 tons a year, and will operate at speeds up to 2000 fpm. It is designed to have an ultimate total of 15,000 hp, although it was started up with 7500 hp. All four stands and the tension reel are powered by direct-drive, double-armature motors operating under adjustable voltage control. On starting, only a single armature was installed on each stand and reel. Power for each motor armature is supplied by a separate generator. With the installation of the second armature, two armatures will be supplied by two generators.

A two-stand temper mill, a 44-in. unit at Kaiser Steel, can roll at speeds up to 4000 fpm. One of the unusual features is a magnetic amplifier tension regulator. This unit gives fast response and good accuracy. The operator has a visual indication of the tension by means of a meter, and can quickly make any desired changes in strip tension. Results can be consistently duplicated. Regulator design also results in low maintenance.

A new arc furnace stirrer, being installed in a Pittsburgh plant, is similar in design to the rotor of an alternating-current generator and is placed at the bottom of the arc furnace, which must have a stainless steel bottom. As the rotor turns, the magnetic field set up by the excited rotor windings moves across and through the molten metal and induces eddy currents

Electrical equipment for 4-stand tandem mill includes 1200-hp, double-armature, reel motor shown in foreground, and twin-motor stand drives having 16,500 hp.



Transformer on new electric furnaces at McLouth Steel are rated at 25,000 kva, but have heat exchangers which increase rating to 33,300 kva.

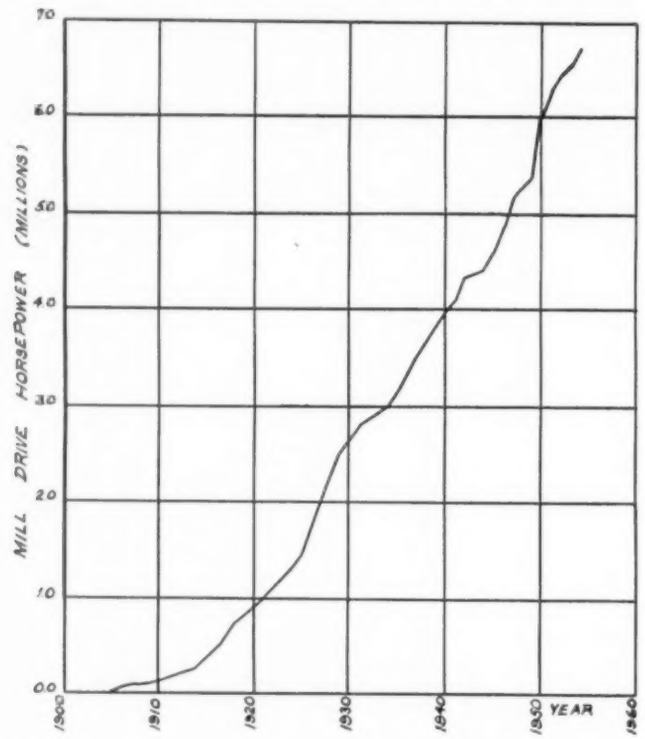
which cause the metal at the bottom to move across the bottom, up the side, across the top, and back down again. A second flow pattern, which can be seen from the surface of the bath, takes the form of two opposite, rotational motions on each side of the line drawn from the charging door to the pouring spout. These flow patterns give thorough mixing of all parts of the bath. The stirrer is air-cooled, is driven by a standard d-c motor of moderate hp rating through a speed reducer, and can have its windings excited from the 250-volt d-c shop bus or from a separate motor-generator set. Fine adjustment of the excitation current and speed and direction of rotation of the stirrer, achieved by the control circuit, makes it possible to accurately adjust the motion of the molten bath as desired. Normal operating speed is expected to be 30-60 rpm.

A new arc furnace control uses electrode motors that run only in one direction, and which are energized directly from the bus without special generators. The control is coupled to an air-counterbalanced hydraulic electrode drive. Test operations at one steel plant for an average thirty day operating period showed power consumption reduced from 520 to 490 kwhr per ton. It was also reported that maintenance was greatly reduced and transformers ran up to 15 degrees cooler. Refractory costs were reduced because of the speed of response. There was no change in electrode consumption in the test plant, which was already down to 6 lb per ton. Lower consumption may be expected if existing consumption is higher than this figure. Other benefits are less circuit reactance, higher power and load factors, faster melting, and fast response (0.05 seconds to stop electrode going at full speed).

The new electric furnaces of McLouth Steel Corp. have a shell diameter of almost 25 ft and can produce 200 tons of steel per heat. The electrodes are 24 in. in diameter and carry currents of more than 3500 amperes at voltages up to 510. Electrodes are driven at speeds up to 90 in. per minute and require a 15-hp rotating regulator control motor.

Scheduled production of transformers in 1954 was 51,000,000 kva. A very definite trend in transformer buying is the adoption of forced-oil cooling for power transformers above 15,000 kva. Only a small percentage is being purchased as self-cooled units. There is also a tendency toward three-phase transformers rather than assembling them out of three single-phase units. Reduced insulation is also being accepted by industry in general.

A development in reducing transformer noise is based on the principle of sound cancellation. The idea is to send out a second sound wave which has the same frequency but opposite phase to that of the actual noise,



Accumulative curve of main drive motors over 300 hp shows a total to January 1, 1955 of 6,696,845 hp. One hundred and nineteen motors (175,705 hp) were added in 1954 of which 106 were d-c and 13 were a-c. This is about 40 per cent more than the total added in 1953.

and thus produce a cone of silence. The added sound is provided by a loud speaker mounted on the transformer tank. Although it cancels out the noise or sound in one direction, it increases the sound level in another.

Extensive research and development have made possible the use of germanium in rectifiers for steel plant applications. One of the many advantages is the high efficiency. In the range of 10 to 20 volts d-c, which is often used on tinning and other types of plating lines, efficiency is as much as 15 per cent higher than any other type of conversion equipment. As an example, at 15-volts, the overall efficiency of a germanium rectifier installation is about 90 per cent. Also germanium does not have aging characteristics.

Several new batteries were demonstrated during the year. One of these develops power from sunlight, and another develops power from nuclear materials. So far, both of these batteries are experimental. Before the year was out, the solar battery had been improved to the point where it would operate at 8 per cent of rated efficiency. The maximum theoretical efficiency is about 22 per cent. The energy in the solar battery is obtained by reflecting sunlight on a specially treated silicon surface. Cells in the battery will deliver power from the sun at the rate of 80 watts per square yard of surface.

Transistors several years ago received a blaze of publicity which died out somewhat as some practical problems slowed down their application to devices and equipment. One of the previous troubles was the extreme care required in manufacturing which made them difficult to put on a mass production basis. A new method was recently developed using an electrolytic etching and indium plating method which makes a surface-barrier type, and the method offers possibilities for mass production techniques. This should lead to a number of new applications.

An electromagnetic clutch, promoted extensively during the year, has been primarily used in Europe. Possible uses in this country are on fan drives, cranes, hoists and other machinery. The clutch is compact and simple, and operates under oil. It can be used for automatic clutching without any intermediate means such as hydraulic fluids, mechanical levers or air cylinders. It consists of an armature on a driven shaft, a lamination stack, a clutch body on the driving shaft with imbedded clutch coil, slip ring and single brush for conducting current to the coil. The energized coil pulls the armature against the clutch body magnetically, compressing the lamination stack and transmitting torque to the driven shaft. By making half of the laminations wave-shaped to act as springs, quick release can be obtained as the springs force the laminations apart. Unlike other lamination-type clutches, the unit is self-compensating for lamination wear. Power consumption is so small that telephone relays can be used for their control. Principal problem so far is the transfer of current from a stationary brush to a moving slip ring under the oily conditions in which the clutch is designed to operate. A practical solution is the use of two concentric brushes made of fine woven metallic wire mesh and independently sprung against the slip ring.

Two new wire insulations which offer important practical possibilities are a new enamel and a new plastic material which has seven times the physical strength and 50 per cent more dielectric strength than class A insulation. This latter material is now available in 100 to 3000-hp motors and as a result will increase motor life.

A company is now ready to manufacture synthetic mica, and will start production in January, 1955. Capacity of plant will be about 1000 tons of mica a year. It is claimed that the synthetic mica will work up to 950 F, whereas natural mica is good only up to 650 F.

An important electrical discovery is a new light amplifier. This is a device that intensifies an optical image by applying energy to the screen rather than by modifying the projection equipment. This is the first time that a method has been found to amplify light without the use of electronics.

Standardization work is being done by the Association of Iron and Steel Engineers to set details for additional larger size motors to be added to the mill motor line. These motors will be similar in characteristics to the present line and will offer sizes in the 275, 375 and 500 hp ratings.

Sales of main drives held up well during the year and were 40 per cent higher than in 1953 and 2½ times that of 1952. Additional hp of main roll drives sold in 1954 totaled 175,705 hp from 119 motors, of which 106 were d-c and 13 were a-c.

ELECTRIC MOTORS OVER THREE HUNDRED HORSEPOWER

APPLIED TO MAIN ROLL DRIVES IN THE IRON AND STEEL AND ALLIED INDUSTRIES DURING 1954

Item	Horsepower	Revolutions per minute	Volts	Frequency	Method of drive	Type of mill	Purchaser	Location	Manufacturer
1	300	300/1070	600	d-c	Geared	Tension reel single stand temper mill	Altos Hornos	Monclova, Mexico	General Electric
2	300	250/625	700	d-c	Geared	Stands 1, 2 rod mill	Bethlehem Steel Co.	Johnstown, Pa.	General Electric
3	300	250/625	700	d-c	Geared	Stand 3 rod mill	Bethlehem Steel Co.	Johnstown, Pa.	General Electric
4	300	250/625	700	d-c	Geared	Stand 4 rod mill	Bethlehem Steel Co.	Johnstown, Pa.	General Electric
5	①300	575/1150	375	d-c	Geared	Temper mill	Empire Steel Corp.	Mansfield, Ohio	Westinghouse
6	①300	575/1150	375	d-c	Geared	Temper mill	Empire Steel Corp.	Mansfield, Ohio	Westinghouse
7	300	300/600	250	d-c	Geared	Temper mill	Empire Steel Corp.	Mansfield, Ohio	Westinghouse
8	300	300/600	230	d-c	Geared	Hot strip mill coiler	Empresa Nacional Siderurgica	Spain	Westinghouse
9	300	300/600	230	d-c	Geared	Hot strip mill	Empresa Nacional Siderurgica	Spain	Westinghouse
10	300	400/1200	250	d-c	Geared	Reversing cold mill	Westinghouse Electric Corp.	Blairsville, Pa.	Westinghouse
11	300	400/1200	250	d-c	Geared	Reversing cold mill	Westinghouse Electric Corp.	Blairsville, Pa.	Westinghouse
12	300	450/1150	250	d-c	Direct	Reversing cold mill	Newman Crosby Steel Co.	Pawtucket, R. I.	Westinghouse
13	†300	720	2300	a-c	Geared	24-in. Rougher drive of rod mill	Packard Electric Co.	Warren, Ohio	Elliott
14	350	500/1250	600	d-c	Geared	10-in. Dual stand for rod mill No. 1 stand	Packard Electric Co.	Warren, Ohio	Elliott
15	350	500/1250	600	d-c	Geared	10-in. Dual stand for rod mill No. 2 stand	Packard Electric Co.	Warren, Ohio	Elliott
16	350	500/1250	600	d-c	Geared	10-in. Dual stand for rod mill No. 3 stand	Packard Electric Co.	Warren, Ohio	Elliott
17	†350	570	2300	a-c	Geared	Sendzimir planetary hot mill	Armzen Inc. for Magnetic, Inc.	Butler, Pa.	Electric Machinery Manufacturing Co.
18	350	350/700	250	d-c	Geared	Copper breakdown	New Haven Copper Co.	Seymour, Conn.	Westinghouse
19	350	300/1200	600	d-c	Geared	Temper mill reel	Alan Wood Steel Co.	Conshohocken, Pa.	Westinghouse
20	350	425/635	600	d-c	Direct	Sendzimir reversing cold mill	Calstrip	Los Angeles, Calif.	General Electric
21	400	300/1100	600	d-c	Geared	Temper mill reel	Alan Wood Steel Co.	Conshohocken, Pa.	Westinghouse
22	400	350/1200	600	d-c	Geared	Sendzimir mill	Wallace Barnes	Bristol, Conn.	Westinghouse
23	400	350/1200	600	d-c	Geared	Sendzimir mill	Wallace Barnes	Bristol, Conn.	Westinghouse
24	400	400/1000	250	d-c	Geared	4-High reversing mill	Follansbee Steel Co.	Pittsburgh, Pa.	Reliance Electric and Engineering
25	400	400/1200	250	d-c	Geared	4-High reversing mill 12-in wide	Simonds Saw Co.	Lockport, N. Y.	Reliance Electric and Engineering
26	†400	600/900	440	a-c	Geared	Scalping machine	Aluminum Co. of America	Cleveland, Ohio	Elliott
27	†450	720	2300	a-c	Geared	18-in. rod mill intermediate stand	Packard Electric Co.	Warren, Ohio	Elliott
28	†500	720	2300	a-c	Geared	Billet mill	Pollack Steel Co.	Marion, Ohio	Westinghouse
29	500	690/1150	600	d-c	Direct	Sendzimir mill	Wallace Barnes	Bristol, Conn.	Westinghouse
30	500	690/1380	600	d-c	Geared	Temper mill	Alan Wood Steel Co.	Conshohocken, Pa.	Westinghouse
31	500	350/700	600	d-c	Geared	Reversing cold mill	Westinghouse Electric Corp.	Blairsville, Pa.	Westinghouse
32	500	500/1220	700	d-c	Geared	Stands 12, 13 rod mill	Bethlehem Steel Co.	Johnstown, Pa.	General Electric
33	500	500/1220	700	d-c	Geared	Stands 12, 13 rod mill	Bethlehem Steel Co.	Johnstown, Pa.	General Electric
34	500	300/600	600	d-c	Direct	Single stand temper mill	Altos Hornos	Monclova, Mexico	General Electric
35	500	250/750	700	d-c	Geared	Stand 14 rod mill	Bethlehem Steel Co.	Johnstown, Pa.	General Electric
36	500	200/600	700	d-c	Geared	Stand 15 rod mill	Bethlehem Steel Co.	Johnstown, Pa.	General Electric
37	600	400/1200	600	d-c	Geared	Reversing cold mill	American Brass	Buffalo, N. Y.	General Electric
38	600	300/600	600	d-c	Geared	4-high non-reversing 48-in. wide mill	Alcoa	Edgewater, N. J.	Reliance Electric and Engineering
39	600	575/1150	600	d-c	Geared	4-high non-reversing 48-in. wide mill	Alcoa	Edgewater, N. J.	Reliance Electric and Engineering
40	600	575/1150	600	d-c	Geared	4-high reversing mill	Seneca Steel	Buffalo, N. Y.	Reliance Electric and Engineering
41	600	575/1150	600	d-c	Geared	4-high reversing mill	Production Steel Co.	Detroit, Mich.	Reliance Electric and Engineering
42	600	300/950	700	d-c	Geared	Rod mill	American Steel and Wire Co.	Cleveland, Ohio	Westinghouse
43	600	250/875	500	d-c	Geared	Temper mill	Empire Steel Corp.	Mansfield, Ohio	Westinghouse
44	*600	514	2300	a-c	Geared	Hot mill	Western Brass	East Alton, Ill.	Westinghouse
45	*600	514	2300	a-c	Geared	Hot mill	Western Brass	East Alton, Ill.	Westinghouse
46	600	250/875	500	d-c	Geared	Cold mill reel	Empire Steel Corp.	Mansfield, Ohio	Westinghouse
47	630	925	550	d-c	Geared	Laboratory blooming mill	General Electric Co.	Schenectady, N. Y.	General Electric
48	①700	300/900	600	d-c	Direct	Cold mill	Kaiser Aluminum and Chemical Co.	Spokane, Wash.	Westinghouse
49	①700	300/900	600	d-c	Direct	Cold mill	Kaiser Aluminum and Chemical Co.	Spokane, Wash.	Westinghouse
50	700	200/680	700	d-c	Geared	Rod mill	American Steel and Wire Co.	Cleveland, Ohio	Westinghouse
51	700	250/790	700	d-c	Geared	Rod mill	American Steel and Wire Co.	Cleveland, Ohio	Westinghouse
52	*800	720	4600	a-c	Geared	Piercing mill	American Brass	Detroit, Mich.	Westinghouse
53	②800	425/1275	400	d-c	Geared	Non-reversing cold mill	Revere Copper and Brass Co.	Baltimore, Md.	Westinghouse
54	*800	900	4000	a-c	Geared	Merchant bar and rod mill 3-high	Fundidora	Monterrey, Mexico	General Electric
55	*800	900	4000	a-c	Geared	Merchant bar and rod mill 3-high	Fundidora	Monterrey, Mexico	General Electric
56	800	300/750	700	d-c	Geared	Stands 10, 11 rod mill	Bethlehem Steel Co.	Johnstown, Pa.	General Electric
57	①②1000	200/900	750	d-c	Geared	Tandem cold mill reel	Weirton Steel Co.	Weirton, W. Va.	General Electric
58	①②1000	200/900	750	d-c	Geared	Tandem cold mill reel	Weirton Steel Co.	Weirton, W. Va.	General Electric
59	1000	350/700	600	d-c	Geared	Reversing hot strip mill	Westinghouse Electric Corp.	Blairsville, Pa.	Westinghouse
60	1000	400/900	600	d-c	Geared	Bar mill	Armco-Rustless	Baltimore, Md.	Westinghouse
61	③1200	225/1050	700	d-c	Direct	Cold mill reel	Usinor	France	Westinghouse
62	1200	150/525	750	d-c	Direct	Winding reel for temper mill	McLouth Steel Corp.	Gibralter, Mich.	General Electric
63	1200	150/525	750	d-c	Direct	Winding reel for temper mill	McLouth Steel Corp.	Gibralter, Mich.	General Electric
64	②1200	150/525	750	d-c	Direct	Reel drive	McLouth Steel Corp.	Gibralter, Mich.	General Electric
65	1250	575/980	700	d-c	Geared	Stand 16 rod mill	Bethlehem Steel Co.	Johnstown, Pa.	General Electric
66	1250	575/980	700	d-c	Geared	Stand 16 rod mill	Bethlehem Steel Co.	Johnstown, Pa.	General Electric
67	1250	225/362	700	d-c	Geared	Stands 5 to 9 rod mill	Bethlehem Steel Co.	Johnstown, Pa.	General Electric
68	1250	150/300	600	d-c	Direct	Temper mill	Alan Wood Steel Co.	Conshohocken, Pa.	Westinghouse
69	1250	225/675	700	d-c	Geared	Rod mill	American Steel and Wire Co.	Cleveland, Ohio	Westinghouse
70	1250	225/620	700	d-c	Geared	Rod mill	American Steel and Wire Co.	Cleveland, Ohio	Westinghouse
71	1250	225/620	700	d-c	Geared	Rod mill	American Steel and Wire Co.	Cleveland, Ohio	Westinghouse
72	1250	60/180	600	d-c	Direct	Bar mill	Armco-Rustless	Baltimore, Md.	Westinghouse
73	②1400	90/300	900	d-c	Direct	Beam mill edger	Inland Steel Co.	Indiana Harbor, Ind.	Westinghouse
74	1500	200/445	600	d-c	Direct	Temper mill	Alan Wood Steel Co.	Conshohocken, Pa.	Westinghouse
75	1500	250/610	600	d-c	Direct	Temper mill	Alan Wood Steel Co.	Conshohocken, Pa.	Westinghouse
76	1500	350/730	600	d-c	Direct	Temper mill reel	Alan Wood Steel Co.	Conshohocken, Pa.	Westinghouse
77	1500	225/580	700	d-c	Geared	Rod mill	American Steel and Wire Co.	Cleveland, Ohio	Westinghouse
78	1500	690/960	700	d-c	Geared	Rod mill	American Steel and Wire Co.	Cleveland, Ohio	Westinghouse
79	1500	300/715	600	d-c	Geared	Cold mill stand	Empire Steel Corp.	Mansfield, Ohio	Westinghouse
80	*1500	514	2300	a-c	Geared	Hot mill	Western Brass	East Alton, Ill.	Westinghouse
81	1500	250/360	730	d-c	Direct	Temper mill	McLouth Steel Corp.	Gibralter, Mich.	General Electric

*Indicates synchronous motor. †Induction motor. ①Twin motor drive. ②Double armature. ③Triple armature.

ELECTRIC MOTORS OVER THREE HUNDRED HORSEPOWER

(CONTINUED)

Item	Horse power	Revolutions per minute	Volts	Frequency	Method of drive	Type of mill	Purchaser	Location	Manufacturer
82	1500	250/360	750	d-c	Direct	Temper mill	McLouth Steel Corp.	Gibralter, Mich.	General Electric
83	1500	225/562	600	d-c	Geared	Sendzimir reversing cold mill reels	Republic Steel Corp.	Massillon, Ohio	General Electric
84	1500	225/562	600	d-c	Geared	Sendzimir reversing cold mill reels	Republic Steel Corp.	Massillon, Ohio	General Electric
85	1500	225/400	600	d-c	Direct	Sendzimir reversing cold mill	Republic Steel Corp.	Massillon, Ohio	General Electric
86	①1500	350/700	600	d-c	Geared	44-in. Reversing cold mill	Crucible Steel Co. of America	Midland, Pa.	Allis-Chalmers
87	①1500	350/700	600	d-c	Geared	44-in. Reversing cold mill	Crucible Steel Co. of America	Midland, Pa.	Allis-Chalmers
88	1500	350/750	600	d-c	Geared	44-in. Reversing cold mill reel	Crucible Steel Co. of America	Midland, Pa.	Allis-Chalmers
89	1500	350/750	600	d-c	Geared	44-in. Reversing cold mill reel	Crucible Steel Co. of America	Midland, Pa.	Allis-Chalmers
90	1625	500/900	750	d-c	Geared	Tandem cold strip mill	Inland Steel Co.	Indiana Harbor, Ind.	General Electric
91	1625	500/900	750	d-c	Geared	Tandem cold strip mill	Inland Steel Co.	Indiana Harbor, Ind.	General Electric
92	1625	500/900	750	d-c	Geared	Tandem cold strip mill	Inland Steel Co.	Indiana Harbor, Ind.	General Electric
93	1750	200/550	700	d-c	Geared	Rod mill	American Steel and Wire Co.	Cleveland, Ohio	Westinghouse
94	2000	575/810	600	d-c	Geared	Rod mill	Wickwire Spencer Steel Co.	Buffalo, N. Y.	Westinghouse
95	2000	300/590	600	d-c	Geared	Cold mill	Empire Steel Corp.	Mansfield, Ohio	Westinghouse
96	2000	125/312	600	d-c	Direct	Cold mill	Empire Steel Corp.	Mansfield, Ohio	Westinghouse
97	2000	150/375	600	d-c	Direct	Cold mill	Empire Steel Corp.	Mansfield, Ohio	Westinghouse
98	①2500	200/400	750	d-c	Geared	Tandem cold mill stand No. 3	Weirton Steel Co.	Weirton, W. Va.	General Electric
99	①2500	200/400	750	d-c	Geared	Tandem cold mill stand No. 3	Weirton Steel Co.	Weirton, W. Va.	General Electric
100	①②3000	300/600	750	d-c	Geared	Tandem cold mill stand No. 4	Weirton Steel Co.	Weirton, W. Va.	General Electric
101	①②3000	300/600	750	d-c	Geared	Tandem cold mill stand No. 4	Weirton Steel Co.	Weirton, W. Va.	General Electric
102	3000	90/225	750	d-c	Direct	Tandem cold strip stand No. 1	Weirton Steel Co.	Weirton, W. Va.	General Electric
103	②3000	690/960	700	d-c	Geared	Rod mill	American Steel and Wire Co.	Cleveland, Ohio	Westinghouse
104	3000	90/300	700	d-c	Direct	Cold mill	Usinor	France	Westinghouse
105	①②3500	350/700	750	d-c	Geared	Tandem cold strip mill stand No. 5	Weirton Steel Co.	Weirton, W. Va.	General Electric
106	①②3500	350/700	750	d-c	Geared	Tandem cold strip mill stand No. 5	Weirton Steel Co.	Weirton, W. Va.	General Electric
107	3500	90/225	750	d-c	Direct	Tandem cold mill stand No. 1	McLouth Steel Corp.	Gibralter, Mich.	General Electric
108	4000	150/300	600	d-c	Geared	Hot strip finishing	Breedband N.V.	Holland	General Electric
109	4000	70/140	700	d-c	Direct	Billet mill	Bethlehem Steel Corp.	Saucon, Pa.	Westinghouse
110	*4000	240	4160	a-c	Direct	Sendzimir hot mill	Washington Steel Corp.	Washington, Pa.	Elliott
111	†5000	514	2300	a-c	Geared	98-in. hot strip mill No. 4 rougher	Republic Steel Corp.	Cleveland, Ohio	Allis-Chalmers
112	②5000	125/390	700	d-c	Direct	Cold mill	Usinor	France	Westinghouse
113	③5000	200/600	700	d-c	Direct	Cold mill	Usinor	France	Westinghouse
114	③5000	300/600	750	d-c	Direct	Tandem cold mill stand No. 4	McLouth Steel Corp.	Gibralter, Mich.	General Electric
115	③5000	225/470	750	d-c	Direct	Tandem cold mill stand No. 3	McLouth Steel Corp.	Gibralter, Mich.	General Electric
116	③5000	200/400	750	d-c	Direct	Tandem cold strip stand No. 2	Weirton Steel Co.	Weirton, W. Va.	General Electric
117	③5000	150/370	750	d-c	Direct	Tandem cold mill stand No. 2	McLouth Steel Corp.	Gibralter, Mich.	General Electric
118	③5250	250/660	700	d-c	Direct	Cold mill	Usinor	France	Westinghouse
119	②7000	80/160	700	d-c	Direct	Beam mill	Inland Steel Co.	Indiana Harbor, Ind.	Westinghouse

*Indicates synchronous motor. †Induction motor. ①Twin motor drive. ②Double armature. ③Triple armature.

MOTOR RECAPITULATION

Company	Location	Type of mill	Number of motors	Total horsepower
Alan Wood Steel Co.	Conshohocken, Pa.	Temper mill	7	7,000
Alcoa	Edgewater, N. J.	4-High non-reversing 48-in. wide	2	1,200
	Cleveland, Ohio	Scalping machine	1	400
Altos Hornos	Monclova, Mexico	Single stand temper mill	2	800
American Brass	Detroit, Mich.	Piercing mill	1	800
	Buffalo, N. Y.	Reversing cold mill	1	600
American Steel & Wire Co.	Cleveland, Ohio	Rod mill	10	13,500
Armco-Rustless	Baltimore, Md.	Bar mill	2	2,250
Armzen, Inc. for Magnetic, Inc.	Butler, Pa.	Sendzimir planetary hot roll mill	1	350
Bethlehem Steel Co.	Johnstown, Pa.	Rod mill	11	7,450
	Saucon, Pa.	Billet mill	1	4,000
Breedband N.V.	Holland	Hot strip finishing mill	1	4,000
Calstrip	Los Angeles, Calif.	Sendzimir reversing cold mill	1	350
Crucible Steel Co. of America	Midland, Pa.	44-in. Reversing cold mill	4	6,000
Empire Steel Corp.	Mansfield, Ohio	Temper mill	4	1,500
		Cold mill	5	8,100
Empresa Nacional Siderurgica	Spain	Hot strip mill	2	800
Follansbee Steel Co.	Pittsburgh, Pa.	4-High reversing mill	1	400
Fundidora	Monterrey, Mexico	Merchant bar and rod mill 3-high	2	1,600
General Electric Co.	Schenectady, N. Y.	Laboratory blooming mill	1	630
Inland Steel Co.	Indiana Harbor, Ind.	Tandem cold strip mill	3	4,875
		Beam mill	2	8,400
Kaiser Aluminum and Chemical Co.	Spokane, Wash.	Cold mill	2	1,400
McLouth Steel Corp.	Gibralter, Mich.	Two temper mills	5	6,600
		Tandem cold mill	4	18,500
New Haven Copper Co.	Seymour, Conn.	Copper breakdown mill	1	350
Newman Crosby Steel Co.	Pawtucket, R. I.	Reversing cold mill	1	300
Packard Electric Co.	Warren, Ohio	Rod mill	5	1,800
Pollack Steel Co.	Marion, Ohio	Billet mill	1	500
Production Steel Co.	Detroit, Mich.	4-High reversing mill	1	600
Republic Steel Corp.	Massillon, Ohio	Sendzimir reversing cold mill	3	4,500
	Cleveland, Ohio	98-in. Hot strip mill No. 4 rougher	1	5,000
Revere Copper and Brass Co.	Baltimore, Md.	Non-reversing cold mill	1	800
Seneca Steel	Buffalo, N. Y.	4-High reversing mill	1	600
Simonds Saw Co.	Lockport, N. Y.	4-High reversing mill drive 12-in. wide	1	400
Usinor	France	Cold mill	5	19,450
Wallace Barnes	Bristol, Conn.	Sendzimir mill	3	1,300
Washington Steel Corp.	Washington, Pa.	Sendzimir hot mill	1	4,000
Weirton Steel Co.	Weirton, W. Va.	Tandem cold mill	10	28,000
Western Brass	East Alton, Ill.	Hot mill	3	2,700
Westinghouse Electric Corp.	Blairsville, Pa.	Reversing cold mill	3	1,100
		Reversing hot strip mill	1	1,000
Wickwire Spencer Steel Co.	Buffalo, N. Y.	Rod mill	1	2,000

Type of Motors Purchased	Number of motors	Total horsepower
Alternating-current motors	13	16,100
Direct-current motors	106	159,605
Total	119	175,705

Phoenix Manufacturing Co. Installs Versatile Rolling Mill

▲ THE new merchant mill recently put into operation by the Phoenix Manufacturing Co., Joliet, Ill., was designed to accomplish the following objectives:

1. A wide range of standard and special shapes at high speed and with a minimum of set-up or change-over cost.
2. Fast finishing of basic shapes in the fewest number of passes.
3. A wide range of billet sizes from 1½ to 8-in. square, as well as rerolling railroad car axles.
4. Double stranding of the smaller product sizes.
5. Maximum production per man-hour through a high degree of mechanization.

A continuous furnace, with inside hearth measurements of 17 ft × 50 ft and a rated capacity of 30 tons per hour serves the mill. The furnace was designed and built by Flinn & Dreffein Engineering Co. Billets or axles enter at one end of the furnace, move down continuously and are discharged on the side. The furnace is fired in a two-zone arrangement by either natural gas or heavy fuel oil, or both. Modern controls assure close temperature regulation. Provision has been made for the future installation of a waste heat boiler to utilize excess heat of waste gases if desired.

The mill features a 3-high, 20-in. roughing stand and six 2-high stands in cross-country arrangement.

Billets and axles are fed to the 20-in. breakdown stand by roller and tilting tables manufactured by the E. W. Bliss Co. The tables are operated from a modernistic pulpit which is the master control station.

There are four 12-in. intermediate stands, a 10-in. leader and a 10-in. finisher, all manufactured by Treadwell Engineering Co. The 10-in. stands were made over-sized with standby equipment that permits fast installation of 12-in. rolls for finishing larger sections. The four 12-in. stands are driven by two 700 hp motors and each 10-in. stand by a 600-hp motor.

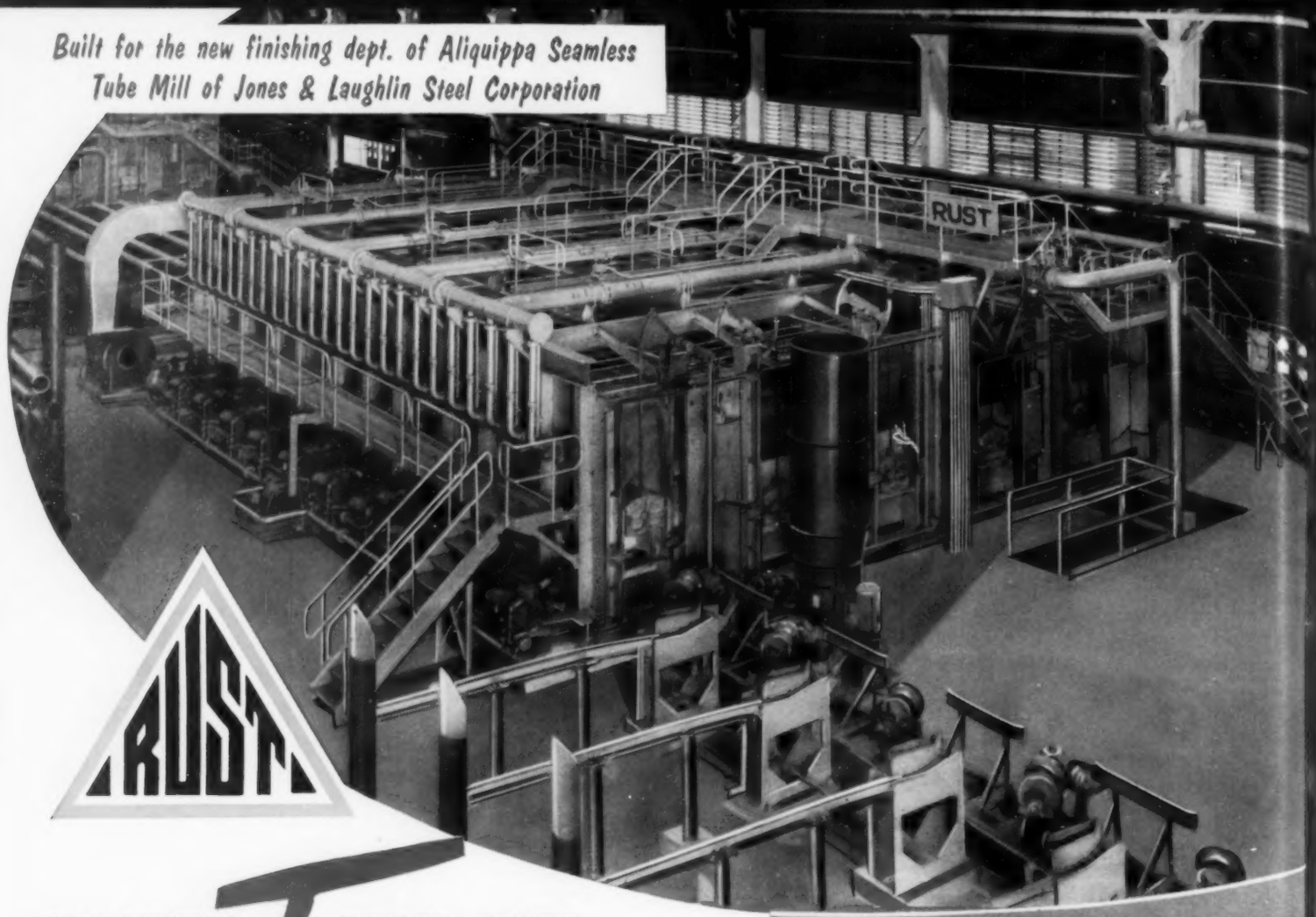
The intermediate and leader stands are provided with five repeaters designed for round bars from ⅜-in. through ¾ in., and for double-stranding rounds from ⅜ in. through 9/16 in. When sections too large to be repeated are to be rolled, the repeaters can be moved laterally and the mill operated in conventional cross-country style. The reversing tables are equipped with transfers for moving the bars laterally from stand to stand. Mechanical bar turners actuated by electric eyes, are provided for flats and for turning ovals when rolling rounds.

To minimize changeover time, extra roll stands allow the six intermediate and finishing stands to be set up on the floor for the next section to be rolled, while the mill is rolling the present schedule. A 15-ton crane is used for changing the stands.

A double, electric flying shear (rotary type) is provided for cutting bars to various hot bed lengths. Finishing speeds will vary from 600 to

Figure 1 — Phoenix Manufacturing Co.'s new merchant mill can roll ⅜-in to 2½-in. rounds and equivalent sections in squares, angles from ¾ in. to 3 in., and flats from 1 in. to 4 in. wide, as well as special shapes.

Built for the new finishing dept. of Aliquippa Seamless Tube Mill of Jones & Laughlin Steel Corporation



WALKING BEAM TYPE HEAT TREATING *Furnaces*

For heat treating their seamless tubing, the Jones & Laughlin Steel Corporation chose two specially-designed Rust furnaces as shown above. These walking beam type furnaces were designed and constructed by Rust in record breaking time—and they are helping the new "J & L" Seamless Tube Finishing Department to break records in producing, conditioning, and finishing high tensile strength seamless tubes.

Be sure to consult Rust on any problem of tube and pipe annealing, heat treating, and processing. Rust also designs and builds other type furnaces to meet every metallurgical heating need.

Interior view showi Walking Beam Ra

FIRST *installation of this type for Normalizing, Quenching and Drawing of Seamless Tubes*

*Walking Beam Rails designed and furnished by York-Gillespie Mfg. Co.

THE WHOLE JOB IS ONE JOB WITH A "RUST PACKAGE CONTRACT"

One contract covers everything, from original idea to start-up. One responsibility for design, manufacture, erection and initial operation. One overhead and profit (with substantial savings to you) on all phases of the work, including wiring and piping.

Rust Furnace Company

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2100 fpm. The cooling bed is 250 ft long, single bank, with two line run-in tables for running two bars. The run-in rollers are individually motor driven. Notched arms walk each bar across the cooling bed, maintaining bar straightness. The cooling bed is served by a back-shear table with two automatic gages that can handle bars up to 60 ft long.

The repeaters, reversing tables, flying shear, cooling bed, and back shear table were all designed and manufactured by the Birdsboro Steel Foundry and Machine Co.

In designing the new mill, space was allowed for four additional 2-high, 16-in. stands between the 20-in. roughers and the cross-country mills. This will eventually increase output by relieving the 20-in. stand of work whenever the roughing and finishing times become unbalanced. Each of the four 16-in. stands would be driven by a separate 1500-hp motor.

Two additional 20-in. stands, one 3-high and one 2-high, are also planned for eventual installation. When added, they will increase maximum product sizes to 4-in. rounds, heavy plates up to 12 in. wide, and angles, channels, etc., up to 4-in. A 1500-hp motor is already installed, ready for work when the expansion takes place.

Electric motors driving the roll stands are adjustable speed, d-c type, to accommodate the range of finishing speeds required by the wide range of products. They are powered by three motor-generator sets located in a modern air-conditioned room. A 1500-kw generator, driven by a 2100-hp synchronous motor, has adequate capacity for the present roughing and finishing stands. A 1450-kw generator driven by a 2500-hp synchronous motor is available to carry the additional load of the future 16-in. intermediate stands. A 1750-kw generator, driven by a 2500-hp synchronous motor, is available as a spare.

LOW HEAT TRANSMISSION PERMITS USE OF THINNER FURNACE WALLS

▲ FUEL engineers are coming more and more to the realization that insulation and firebrick construction does not provide too effective a means of sealing refractory construction against leaking hot gas or air infiltration. Ramtite construction, by the elimination of joints, not only provides a tight monolithic surface, but also, by its lower "K" value, reduces thermal conductivity.

Ramtite plastic refractories have a definitely lower thermal conductivity than fireclay brick. Tests run in an independent laboratory show that "K" value of the material is even lower than guaranteed.

In confirmation of these laboratory tests, a test was made recently in a steel mill furnace where temperature readings were taken daily over a period of several months at the hot face, at the junction of the plastic refractory and at the outside plate. The results shown from these tests and others are consolidated in Figure 1.

One method of taking advantage of these higher insulating values is to keep the heat loss constant and reduce the overall wall thickness by substituting plastic refractories for firebrick as shown in the illustration. In the case of the new furnace installations, the sidewall thickness can be reduced over 25 per cent because of the higher thermal efficiency. This will result in a substantial construction savings.

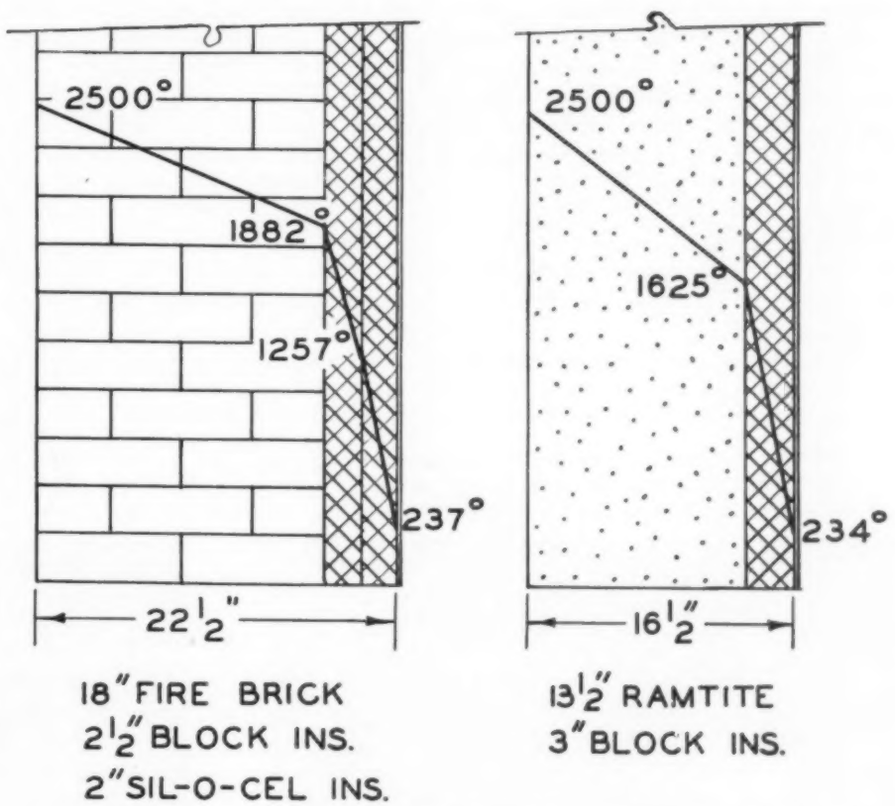

Figure 1 — Lower heat transmission through plastic refractory permits use of thinner walls with equal or lower heat loss.

Similarly, in existing furnaces reduction of sidewall thicknesses can substantially increase furnace capacity without sacrificing efficiency.

MATERIAL HANDLING AT ATLANTIC STEEL

▲ATLANTIC Steel Co. was originally formed, in 1901, to manufacture cotton ties used in the baling of cotton. Through the years the company grew and diversified to the point where now it manufactures a wide variety of steel products under the trade name of "Dixiesteel." These products include angles, plain rounds and squares, cotton ties, hand rail sections, farm fence and fence posts, barbed wire, nails, pump rods, wagon hardware, welding flanges, and metal forgings and stampings.

The firm has only one plant—in the northwest section of Atlanta—but its manufacturing facilities cover 193 acres, 20 of which are under one roof. Its employees number about 2000. There are 13 miles of railroad track on the plant grounds.

Steelmaking facilities include one 75-ton capacity Lectromelt top charge electric furnace and three 80-ton capacity open hearth furnaces. Steel processing facilities include five soaking pits, a blooming and billet mill, a rod mill and a wire mill. End products are made in the manufacturing department, wire and job galvanizing departments, and fabricating division. In addition to a general warehouse division, each department has its own warehouse section.

The operation — The first Clark truck was bought in 1937 and now the company owns 29 Clarks, both gas and electric powered. Before this equipment was utilized materials were handled by hand, in push trucks or by overhead cranes. Now all semi-finished and finished products eight feet or less in length are handled with lift trucks, while overhead cranes are used to handle longer items.

The general picture of materials handling at Atlantic Steel is one of inter- and intra-department movement of supplies and products. Items are picked up at production machines and transported to warehouses and storage areas, or taken directly to docks for loading aboard trailers or railroad cars. (The longest single haul by fork truck is about 1000 feet.)

A large percentage of the materials handled are palletized. In 1940 Atlantic began palletizing nails, field fence, barbed wire and similar products.

A list of the palletized materials handled would include: steel sheets, roof drainage material and accessories, coiled sheets, floor plates, expanded metal, coiled strip, coiled hoop, nuts and bolts, wire products, small coils of wire, coiled bale ties (packaged in 87-lb cartons), welding rods (packed in wooden boxes or bundled in lots), spools of barbed wire, field fence, nails in nail pans, nails in caddys (packaged in lots of 100-lb for customer shipment), forgings and stampings, furnace refractories, cement and brick.

Unpalletized items handled directly by forks include: pallets for carrying coiled wire, industrial and residential chain link forgings, welded wire mesh, unit loads of steel sheets, roof drainage materials, floor plate, tote boxes, forgings, electrodes for use with the electric furnace, and nails in lots in large steel tote pans.

Rams from six to 15 ft long handle wire rods, coiled wire, unit loads of forgings and stampings, uncoiled bale ties, pipe hanger strip, fence posts and poultry netting. A 360-degree rotating fork device is used to transfer nails from tote boxes to cleaning machines.

As indicated by the large amount of railroad track on the plant grounds, most of Atlantic's shipments are by rail. Since World War II, however, truck shipments have gradually increased and now total more than 35 per day. Some two-thirds of this number are accounted for by customer pick-up. Whenever possible fork trucks are used to load both rail cars and trailers, with better than 50 per cent of all outgoing shipments loaded in this manner.

Figure 1 (left) — Special pusher ram attachment is used to push steel scrap from furnace door opening and from furnace walls. This is the largest furnace (electric) in the South. Figure 2 (right) — Truck lifts a 5000-lb load of coiled wire (palletized) from the wire drawing machine.

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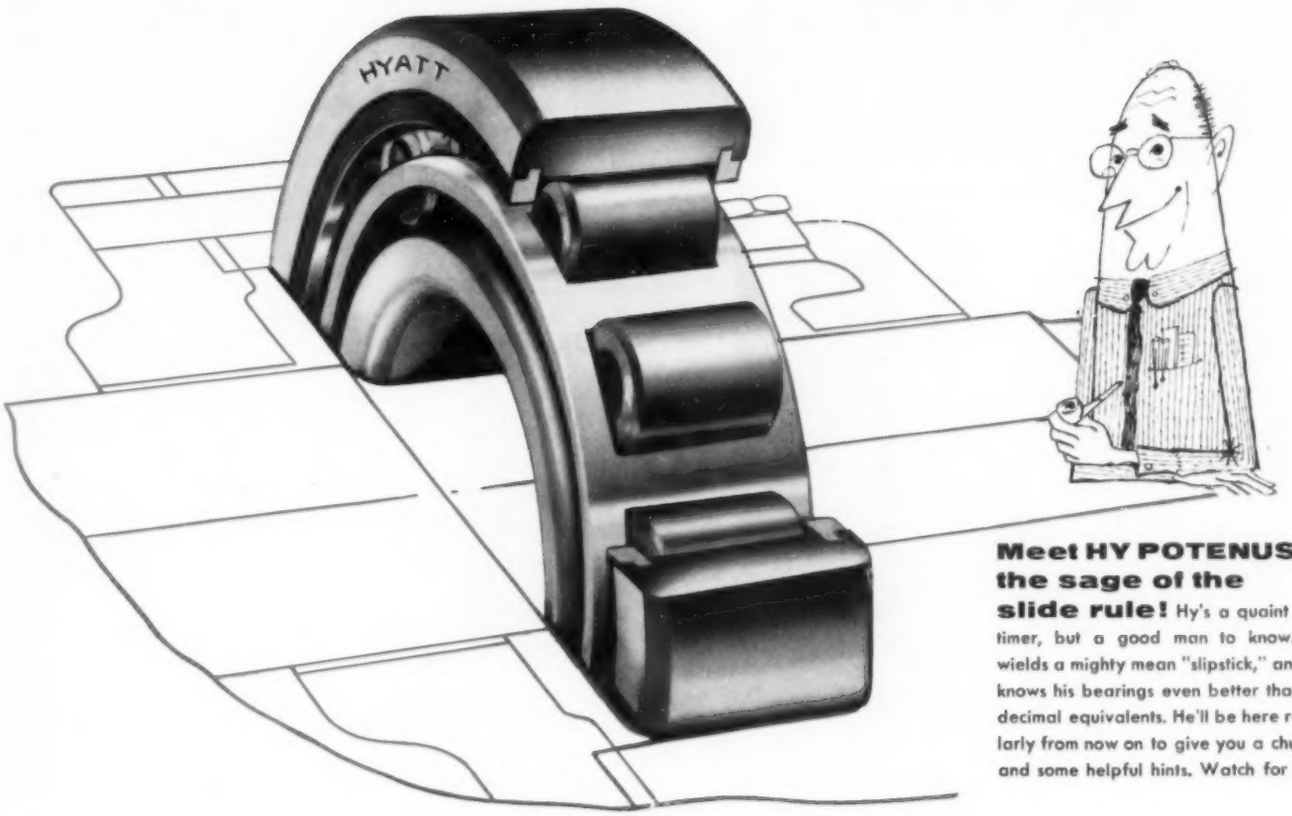

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HY SAYS:

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But a HYATT Cylindrical Roller Bearing solves all those problems so simply! It allows the shaft to float horizontally—"free lateral," we call it—and automatically compensates for expansion *without changing the bearing centers.* If you haven't a HYATT catalog handy, better send for yours right now. It'll show you exactly which bearing to use where, and help you find the *right* answers to a lot of pesky bearing problems. *Remember, you can't go awry when you specify—*

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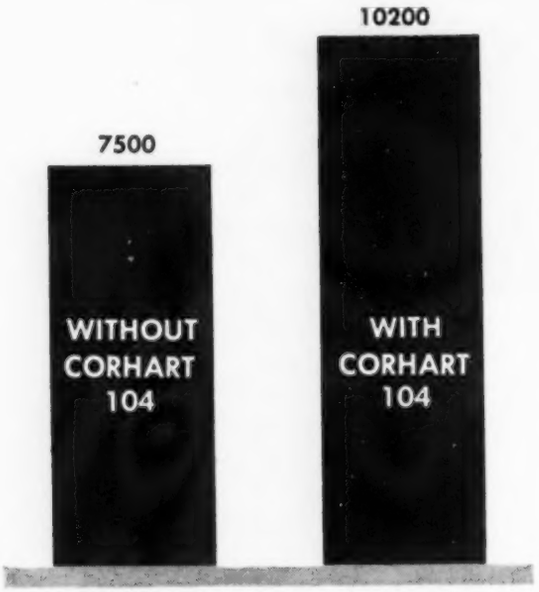
8% of CORHART 104 in the Sidewall Helps Produce 37% More Steel!



AVERAGE TONNAGE PER CAMPAIGN

CORHART 104 is a new, different, magnesite-chrome refractory which is electrically-melted at 4500°F, and poured into its final shape. It is a *special* material, possessing *special* characteristics, and is used for reinforcing hot spots, *rather than for complete furnace construction.*

One example: An electric-furnace operator, melting high-quality steel, reinforced only 8% of his total sidewall area with Corhart 104 refractory castings. Since strengthening these vulnerable areas, he has averaged 37% more heats per campaign, for the past two years. This amounts to an average of 2,775 extra tons of steel per campaign.

During the last five campaigns on this furnace, this operator has averaged 42% more heats per campaign.

Let us tell you the whole Corhart 104 story, and explain how *little* Corhart 104 it takes to achieve really substantial savings. Write for full details, today. Corhart Refractories Company, *Incorporated,* 1610 West Lee Street, Louisville 10, Kentucky, U.S.A.

QUALITY ECONOMY ENDURANCE

CORHART 104 ELECTROCAST REFRACTORY

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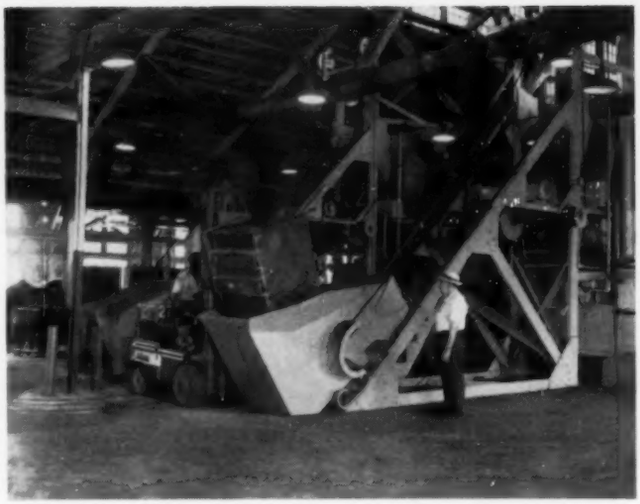

Figure 3 — Truck with special 360-degree rotating device empties a 2000-lb capacity steel nail box into hopper of cleaning machine.

Figure 4 — Cotton ties used in baling cotton are lifted in 2250-lb loads from a stack by truck with a special attachment.

Daily operation of the fork trucks is determined largely by production schedules. As a plant-wide average, the trucks are in operation for six hours of an eight-hour shift, with shifts fluctuating between one and three per day. On many occasions the trucks have operated on a round-the-clock schedule.

THE PROCEDURES

To best describe the materials handling techniques at Atlantic Steel, this report will treat the various departments and divisions separately, giving examples of fork truck use.

Steelmaking — At the electric furnaces a 6000-lb electric truck loads billets from alligator shears to the reheating furnace charging platform at the eight-inch hoop mill furnace. Individual loads run from 3000 to 4000 lb., with six tons per hour being handled on a schedule of three-shifts-per-six-day-week.

At the ten-inch hoop mill furnace, another truck moves 4000 to 5000-lb loads at a rate of seven tons per hour on a two-shift-per-five-day-week schedule.

In a highly unusual operation, a gas-powered unit equipped with a long ram attachment is used to push steel scrap into the furnace. The ram is substituted for the regular forks whenever this operation is necessary. Operating efficiency of the fork truck has not been affected by the high temperatures encountered near the furnace.

Steel processing — In the rod mill, heated wire rods in coils, are moved from the mill to an outside storage area on a train of platform trucks. Ram-equipped fork trucks remove the coils from the train and place them in tiered rows for cooling. After cooling the coils are again picked up by fork trucks and transported to the wire mill for additional processing.

At the wire mill the coiled rods are cleaned and then delivered by fork truck to the 14 wire drawing machines. Here a 4000-lb gas-powered carloader with a six-foot ram attachment moves 220 tons of coiled rods per eight-hour shift. After the wire drawing operation, the wire is coiled and palletized for removal by a 4000-lb electric carloader to various job locations and to rail cars for shipment. A clarkat with standard coupling pulls trucks, removes scrap and handles miscellaneous chores on the wire-bundling floor. A 4000-lb gas carloader and a 6000-lb electric Utilitruc stack wire at galvanizer reels, pick up galvanized wire at reels and carry it to field fence and barbed wire machines, and distribute annealed wire to various processing machines. On both these trucks both standard forks and six-foot ram attachments are used. The weight of the individual loads range up to 4000 lb. In the wire storage warehouse, another truck is used to tier palletized sections to wire field fence. Tiers reach a height of 11 feet.

Manufacturing and fabricating — Working in close quarters in the nail mill, a 3500-lb gas carloader, equipped with a 360-degree rotating fork device, is used to move pans and boxes of nails around the manufacturing area and to store and tier nail caddys in the warehouse. From nail-making machines, nails are discharged into either 100-lb capacity pans or 2000-lb capacity boxes. Pans are stacked on pallets and carried by fork truck to tumblers where the nails are cleaned. Boxes are carried by the fork truck to a cleaning machine and, with the aid of the rotating device, dumped into a large hopper which lifts the nails into the machine. After cleaning the nails are packaged, palletized and removed to storage. Fork trucks move 50 tons of uncleaned nails and 1000 caddys per shift on a two-shift-per-five-day-week schedule. In the nail warehouse, the carloader handles 220,000 lb of palletized nail caddys in an eight-hour shift. Caddys are stacked 32 per pallet. When caddys are ready to be shipped, the truck and one operator and helper load a 40-ton capacity freight car in one hour.

As previously stated, Atlantic Steel was originally organized to manufacture cotton ties, and ties are still an important part of the firm's operation. Loading of the ties had always been something of a problem before trucks were utilized, but now the operation is smooth and rapid. Ties are compressed into bundles by hydraulic presses, and 50 bundles are bound together in a package. A truck equipped with a ram fixed with hooks picks up a 2250-lb package from the storage area or loading dock and hauls it into a freight car. Two men and a truck load a 40-ton capacity freight car with ties in 90 minutes. In 1953, 700,000 bundles of ties were loaded in this way by the fork trucks.

In the manufacturing department's "hot shop," another truck is kept

Figure 5 (left) — Fork truck lifts a die block into position on the 1200-lb board drop hammer in the manufacturing department "hot shop." Figure 6 (right) — A truck in the wire storage warehouse lifts palletized 5-ft wire field fence 11 ft for storage.

busy supplying materials to the various machines. A common operation finds the truck moving die blocks into position on one of the drop hammers.

In Atlantic's galvanizing department, a Yardlift has a variety of chores. Using a specially designed scoop, it moves sand. Using standard forks it moves 550-gal drums of chemicals to vats in loads of about 500 lb each. Raising a one-ton air hoist so that it can be hooked to overhead crane rails is another job for the Yardlift. This is accomplished by simply placing the hoist on a stack of pallets and lifting the pallets to the desired 20-ft height.

In the fabricating division, four or five gas carloaders move field fence, in 2000-lb palletized loads, from production machines to warehouse storage and later to trailers and freight cars. In the warehouse, the fence is tiered to a height of 17 ft. A 30-ton capacity freight car is loaded with fence in 90 minutes. A 2000-lb electric clipper is used as an auxiliary truck for lighter loads, especially in loading vans and in low-ceiling clearance areas. In the warehouse, 1500-lb bundles of seven-foot field fence posts are tiered by a truck with a ram attachment.

Atlantic's incoming steel products are temporarily stored in the warehouse division. Here two electric carloaders handle such items as sheets, wire products, industrial and residential fencing, floor plate, expanded metal and roofing and drainage products. For these multi-purpose tasks, ten-foot ram attachments are often substituted for forks. The loads — some palletized and some in bundles — range up to 4000 lb.

MAINTENANCE

All maintenance and repair work on the machines is done in Atlantic's truck and tractor shop by competent mechanics under qualified inspection and supervision. Every 48 hours all gas trucks undergo a check-up which includes any necessary repairs and cleaning of air filters. A weekly service check includes oil change, lubrication, hydraulic system inspection and mechanical inspection. Once a year the gas trucks are given a complete engine overhaul.

Batteries of the electric trucks are inspected daily and charged every eight hours. The batteries are cleaned once a month. As with gas trucks, the electrics get a complete overhaul every year.

Since the company is using only Clark equipment, no comparison can

Figure 7 — Seven-foot field fence posts, in bundles weighing 1500 lb, are tiered by ram-equipped truck in warehouse.

Figure 8 — Trucks are repaired and maintained at the truck and tractor shop.

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1000 Kva, 3 Phase 60 Cycles, 150°C. Rise
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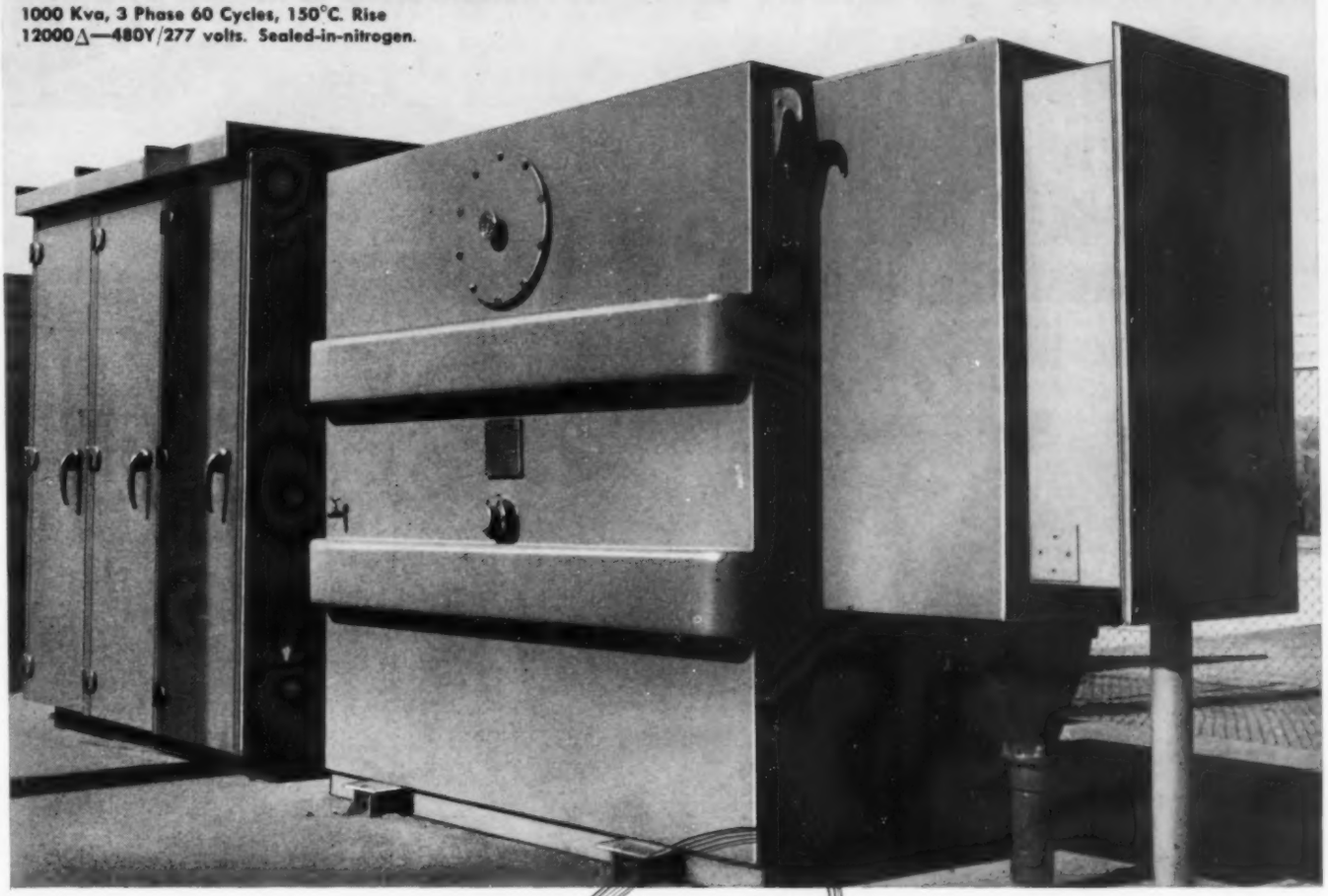

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	KVA	VOLTAGE
VENTILATED	UP TO 3000	UP TO 15 KV
SEALED IN NITROGEN	UP TO 2000	UP TO 15 KV

Consider these Advantages:

- No fire or explosion hazards
- Lowest fire insurance rates of any transformer
- Transformer least affected by water
- Exceptionally high overload capacities
- Requires minimum maintenance — even in contaminated areas

For further information on Pennsylvania Class H transformers, we invite you to write to Pennsylvania Transformer Company, Box 330, Canonsburg, Pa., and ask for your free copy of Bulletin 951 — "H . . . in a Class by itself."

pt PENNSYLVANIA TRANSFORMER COMPANY

A McGraw Electric Company Division • CANONSBURG, PENNSYLVANIA • *Greater Pittsburgh District*

LONGER IDLER LIFE STARTS *HERE*

Positive grease seal of LINK-BELT IDLERS is the most effective on the market

NO BELT CONVEYOR IDLER is any better than its bearings. And no bearing outlasts its grease seals. That's why the seals on Link-Belt roller bearing idlers are so important to you.

The result of many years of intensive laboratory and field testing—the positive Link-Belt seal excludes dirt and moisture—retains lubricant. Felt and neoprene are combined with steel retainers and spacing collar to make an accurate cartridge labyrinth seal. There are no springs, no loose washers, no possibility of metal-to-metal contact.

And this is just one of the many engineering extras that make Link-Belt Idlers last longer. Check the box at right. Then ask your nearby Link-Belt office or distributor for a copy of new 48-page Book 2416. See for yourself how industry's most comprehensive line of idlers can mean lower handling costs for you.

6 other reasons why LINK-BELT IDLERS cut handling costs

1. **HUSKY, HIGHEST QUALITY BEARINGS,** free and easy turning, assure maximum life, minimum belt-wear, low power consumption.
2. **SAFE, CONVENIENT GREASE FITTINGS** provide ease of lubrication—lubrication for longer life.
3. **CONCENTRIC ROLLS** have smooth surfaces and rounded edges. Machine-made, continuous welds prevent entrance of dirt and moisture.
4. **OUTER SHELL COUNTERBORES AND COUNTERBORES AND JOURNAL** of the heavy 3/16" thick wall bearing retainer tubes with the press fits of the roll head assures hop-free rotation.
5. **STRONG, RIGID FRAMES** support rolls in perfect alignment. Rolls are securely held in place but can be easily removed for inspection and service.
6. **GROOVED HEX NUTS** lock into malleable brackets, creating truss effect—prevent shaft rotation and bracket spreading under both vertical and impact loads.

LINK-BELT

THE SYMBOL OF QUALITY — LINK-BELT

BELT CONVEYOR IDLERS

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13,522

be made with other equipment as to maintenance and operating efficiency. Management feels, however, that maintenance costs are unusually low for the type of work. Credit for this is given not only to the machines but also to a constant, concentrated program to educate fork truck drivers in the care and handling of their machines.

An outstanding example of the value of this driver care program is the record established by one driver and his truck in the nail mill. For five years this operator drove the same truck, moving an average of 50 tons of nails every day. This driver came to a full stop before changing gears. He did not "scratch off" when starting out. He always reported any need for repair or adjustment to his truck. In five years this team handled 62,500 tons of nails. In this period the only major repairs to the truck were the replacement of one clutch and replacement of one set of drive tires.

Another truck in the hoop mill has an almost similar record. Since it was put into operation in 1949, this 6000-lb gas utilitruc has required only minor repairs, a record attributed by management to careful driving and a quality machine.

SUMMARY

Since this equipment has been used for so long at Atlantic Steel, no cost figures are available to illustrate the savings resulting from the switch to fork trucks from other methods. But according to company officials, there is no doubt that the maneuverability and high load-handling ability of the trucks has greatly increased the ease and speed of the handling operation. The trucks keep materials flowing through the plant to meet production and shipping schedules and thus are a key to keeping customers serviced and satisfied.

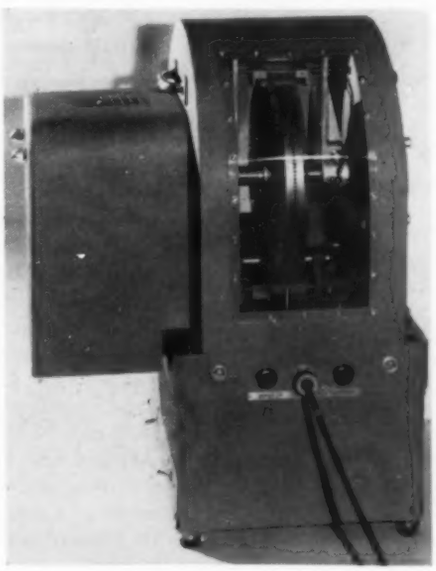
MEMORY DEVICE AIDS IN CONTINUOUS PROCESSING LINES

▲ THE proportional syncronizer, a device for storing a meter reading of varying magnitude and reproducing that information at a later period in a process, synchronized with the speed or movement of the processing line was recently developed by Pratt & Whitney Division, Niles-Bement-Pond Co. In operation, a meter reading from a gage is applied to the memory unit through a self-balancing electronic control circuit. The device storing this reading is driven from the process line in the same relation that the material is progressing through the process, and the advancement of the information on the memory unit is in relation to this movement in both speed and distance.

An application is in the control of a process where steel strip, of varying thickness, is being formed into tubing and seam welded. The welding current must be varied in accordance with the thickness of the strip. If the current were held constant, and the material became thicker, a weak weld would result; and if the material became thinner, the seam would be burned. Since it is impractical to measure the thickness of the material at the point of welding, it is done before forming into a tube. The proportional syncronizer is therefore used to convey the information on thickness between the point of measurement and the point of welding, and to control the welding current accordingly.

Another example of an application is in the processing of coated materials where it is desired to know accurately the weight or thickness of the coating.

Figure 1 — Unit stores variable meter readings for subsequent control in continuous processing operations.



A gage is employed to measure the base material continuously and the varying dimensional reading from this gage is fed into the proportional syncronizer. As the measured material progresses through the coating process, the meter reading progresses proportionally in the memory device. A second gage is then employed to measure the base material plus coating. The reading of the first gage after being delayed in the memory unit, is subtracted from the reading of the second gage. Inasmuch as the memory unit has delayed the reading of the first gage an amount equivalent to the time required for the specific portion of the base material to reach the second gage, the difference in the two readings is a measure of the coating thickness of that portion. By the use of the proportional syncronizer an accurate measure of the coating thickness only is obtained, even through the base material may vary from portion to portion by amounts greater than this coating thickness.

The proportional syncronizer can be applied to the storage of any meter reading of varying magnitude where subsequent use of this meter reading is required in a process operation.

"The Lower Temperature Rise of FUSETRON FUSES Solved a Serious Shutdown Problem for Us"

J. F. Getz
Chief Engineer,
University of Denver
Denver, Colorado

"The fine, new Field House we built in 1949 included an ice skating rink. The ice making equipment uses two 3 phase, 220 volt, 100 hp., compressor motors having a running current of 246 amperes.

"Ahead of the magnetic starters for these motors were two 400 ampere safety switches originally equipped with 400 ampere renewable fuses.

"Shortly after the compressors went into service heat began developing in the safety switches. The fuses were running very hot — in fact to such a degree that the links in the fuses were melting and causing as many as three shutdowns a week.

"In August of 1951 I saw a demonstration by a BUSS representative that showed how much cooler was the operating temperature of Fusetron fuses.

"Right then, I determined to try out Fusetron fuses in these two switches. To get better protection I dropped the fuse size down to 300 amperes.

"With the installation of Fusetron fuses the heating immediately disappeared and so did the shutdowns it formerly caused.

"The lower temperature rise of Fusetron fuses solved a serious shutdown problem for us."

YOU TOO, CAN MINIMIZE PLANT SHUTDOWNS AND EQUIPMENT LOSSES BY INSTALLING FUSETRON FUSES — THEY GIVE 10 POINT PROTECTION

1 Protect against short-circuits. **2** Protect against needless blows caused by harmless overloads. **3** Protect against needless blows caused by excessive heating — lesser resistance results in cooler operation. **4** Provide thermal protection — for panels and switches against damage from heating due to poor contact. **5** Protect motors against burnout from overloading. **6** Protect motors against burnout due to single phasing. **7** Give DOUBLE burnout protection to large motors — without extra cost. **8** Make protection of small motors simple and inexpensive. **9** Protect against waste of space and money — permit use of proper size switches and panels. **10** Protect coils, transformers and solenoids against burnout.

And with FUSETRON FUSES you have Greater Safety, because of their 100,000 amp., Interrupting Capacity Rating

Tests verified by the Electrical Testing Laboratories of New York show that Fusetron fuses, on loads under 600 amperes, can interrupt safely the most severe available short circuit currents.

The test circuits were set to deliver far in excess of 100,000 amperes — yet the 250 and 600 volt Fusetron fuses on each and every test cleared the circuit without igniting readily flammable material placed around the fuses . . . and there was comparatively little noise.

You get all this added safety for every set of fuse clips in your plant without changing a panelboard or switch

No Interference with time-lag

Fusetron fuses' time-current characteristic, of the utmost importance to give proper motor and electrical protection and to eliminate needless blows, has in no way been disturbed.

Maximum Safety

With Fusetron fuses there is no cascading of interrupting rating — no places where an excessive fault current might cause serious damage. Every Fusetron fuse has an interrupting rating in excess of 100,000 amperes.

You don't have to worry about selecting chosen spots in which to pay extra for "safe" equipment. Wherever a Fusetron fuse is installed you have safety as sure and dependable as you can buy — no matter what you pay.

No Maintenance Costs

Once properly installed Fusetron fuses are maintenance free. They require no costly inspection or down-time for calibration and other maintenance necessary on mechanically operated devices.

Dust, fumes, corrosion or age cannot prevent a Fusetron fuse from opening safely. There are no hinges, pivots or contacts to stick or slow down the operation of the fuse on short-circuit.

No Recalibration Costs

When a Fusetron fuse does blow, there is no recalibration needed. As quickly as the fault in the circuit is corrected, you slip in a new fuse that has been CALIBRATED AT THE FACTORY BY ENGINEERS — a fuse that is as safe and dependable as the one that blew.

For High Interrupting Capacity above 600 and up to 5000 amps. — Install BUSS Hi-Cap Fuses

BUSS Hi-Cap fuses offer unlimited interrupting capacity for circuits of 600 volts or less. Their high speed operation on heavy shorts limits current to safe values. This minimizes damage to equipment and cuts down dangerous stresses on transformers.

When coordinated properly with Fusetron fuses they will not open ahead of the fuse nearest to the fault—thus the trouble is isolated to the part of the circuit in which the fault occurs.

Added Safety on Old Installations

On installations where the increase in the capacity of the circuit has outgrown the interrupting rating of the circuit breakers, BUSS Hi-Cap fuses offer a safe and relatively inexpensive way to protect inadequate breakers against rupture in event of a bad fault.

PLAY SAFE—Install FUSETRON Dual-Element Fuses and BUSS Hi-Cap Fuses throughout the entire electrical system . . . Today!

One needless shutdown . . . one lost motor . . . one destroyed switch or panel . . . one burned out solenoid . . . may cost you far more than replacing every ordinary fuse with a Fusetron fuse on loads up to 600 amps — and BUSS Hi-Cap fuses on loads above that.

Blowing time charts and more information are available. Write for bulletins FIS and HCS.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

BUSSMANN Mfg. Co.
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Please send me complete facts about FUSETRON dual-element Fuses and BUSS Hi-Cap Fuses.

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Planned Battery Maintenance Aids Material Handling

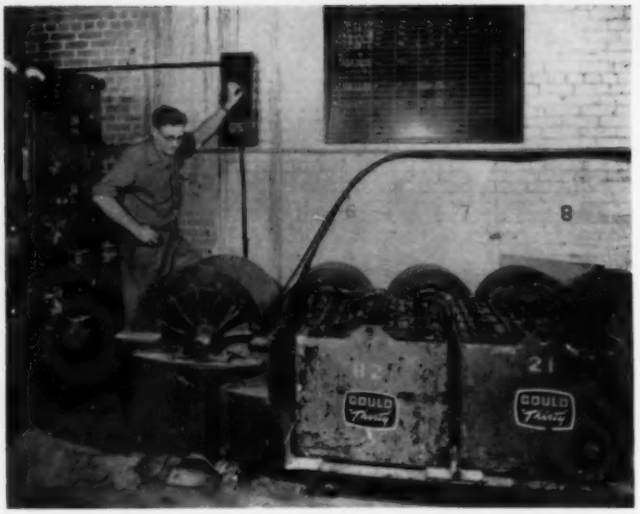


Figure 1 — Blower forces air under batteries on charging rack to keep battery temperatures down during charging. In addition, large fan blows air over top of batteries toward exhaust blower which takes any possible gas or fumes out of the shop.

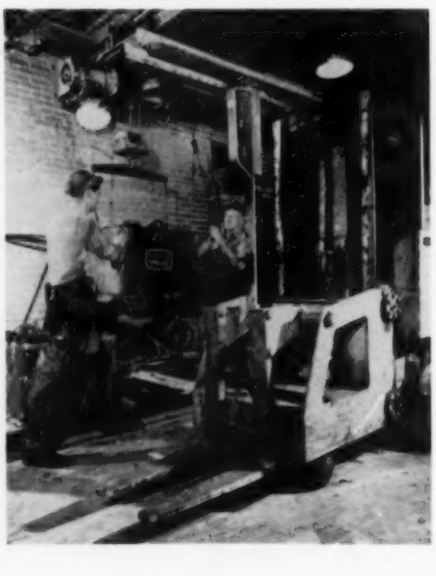
▲ FORTY-FIVE industrial trucks of several types and ranging in capacity from 3000 to 12,000 lb are operated at the Yorkville Works, Yorkville, Ohio, of the Wheeling Steel Corp. Because the plant area is so large, battery charging, maintenance and repair are accomplished in two large, well-supervised shops designated "North" and "South." While both shops have similar facilities for charging, the South shop specializes in battery repairs while the North shop is well set up for making repairs on the trucks themselves.

The South shop is the older of the two, in operation since 1936. The battery rack in this shop is fabricated of two continuous heavy, steel rails divided into spaces for 15 batteries, placed against a wall. Charging leads, hose for compressed air and distilled water from a still within the battery shop are fixed against the wall out of the way and yet close to the batteries and accessible to the battery maintenance men. The batteries are well-ventilated. A large blower directs air over the battery racks toward an exhaust blower which pulls air out of the shop. Another blower (Figure 1) directs a flow of air under the batteries to provide a more direct cooling effect to permit continuous charging even in hot weather without danger of overheating.

The North (No. 2) shop is similar to the South shop with heavy railroad type rails forming the base of the rack. External blowers only are used in the South shop at present, but Wheeling Steel plans to install a blower to direct air under the batteries in the North shop.

Motor-generator sets furnish the power for charging in each shop by a modified constant voltage system with a time voltage relay to give a finishing rate of three hours automatically.

Figure 2 — Simple spreader bar attached to hoist handles batteries in and out of trucks. The special holding attachment on truck receiving the charged battery is used for carrying large loads of empty pallets which would otherwise be unsteady. Truck can then be used for normal operations because it is out of way of normal loads.



In both shops battery handling is done by a hoist, which can service any part of the shop, and spreader bars of Wheeling Steel design (Figure 2).

Of the 67 batteries in use, all except two are the same size (Figure 3) and can be interchanged on any of the trucks. Because of the increased duty required of the trucks, Wheeling Steel recently purchased two new 15-cell Gould batteries of 600 ampere-hour capacity to compare in performance with the present standard 15-cell Gould battery of 550 ampere-hour capacity. Both types are the same size. The increased capacity is obtained by means of the new diamond-Z grid which gives five more ampere-hours per positive plate. The new batteries also have a bolted disconnect on the negative terminal so that the negative part of lead can easily be disconnected to avoid shorting when it is necessary to change or repair the plugs.

All batteries receive an equalizing charge once a month which accounts, in part, for the excellent battery life of 5 to 6 years achieved at Wheeling Steel in heavy service.

An ingenious device has been developed to handle empty wooden pallets which are light but bulky.

How Do Lightweight Refractories Cut Fuel Costs And Boost Furnace Output?

Here, certainly, is a timely question. There's a heavy squeeze today on most furnace operators for lower costs, larger production . . . or both. And despite all the economies they've put into effect so far, they're still searching hard for ways to make their furnace dollars do a bigger job.

The following discussion brings out a number of facts, often overlooked, about the money-saving, profit-building potentials inherent in *lightweight* insulating firebrick.

Q. *First of all, just what do you mean by "lightweight" insulating firebrick?*

A. Compared with dense, fireclay brick weighing approximately 7½ to 8½ pounds each, insulating firebrick range from about 3½ pounds down to slightly over 1 pound for various temperature requirements.

Q. *What does this light weight have to do with lower production costs?*

A. Briefly, heavy furnace linings waste your fuel dollars two ways:

They soak up and store large quantities of heat which are lost when the furnace is cooled; and they conduct and lose too much heat through the wall.

Lightweight insulating firebrick, on the other hand, contain millions of tiny air cells, heat up and cool quickly, absorbing and storing very little heat. Also, they resist heat flow, keeping it inside the furnace to do productive work.

Q. *I can see why you would save on fuel — but how much?*

A. There's no single answer to that question—there are too many variables to be considered. But to give you an idea of these savings, here are a few actual examples:

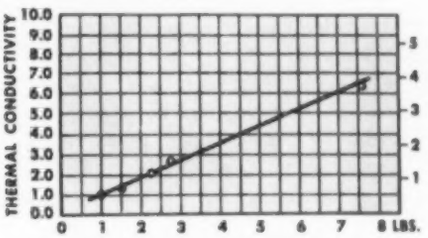
The operator of a large forge furnace cut his fuel costs more than 50% after changing to *lightweight* insulating firebrick.

A manufacturer of electric kilns states that insulating firebrick result in heat savings of fully 25%.

A magnesium melting crucible furnace that formerly used 1,000,000 BTU's per hour now does the same job with 500,000 BTU's, thanks to insulating firebrick.

Q. *Increased production has also been pointed out as an advantage of insulating firebrick. How do you explain this?*

A. Again the answer lies in lightness of weight. Because lightweight firebrick store and conduct less heat, they come up to operating temperature faster — cool down faster, too. This means — shorter heating cycles.



Relation between weight and thermal conductivity for several brands of kaolin base refractories. (mean temperature, 900F)

Secondly, because lightweight firebrick conduct far less heat than heavy, dense firebrick, you don't have to build as thick a wall. This gives you more hearth area per square foot of floor space.

Thirdly, lightweight firebrick respond more rapidly to changes in furnace heat input, which means closer temperature control and fewer rejects in many instances.

It's just like adding extra furnace capacity without adding to your furnace investment.

Q. *Are there any differences in the performance of the various brands of insulating firebrick available?*

A. Naturally, the *lighter* the brick the greater the fuel savings and furnace output. And the lightest insulating firebrick of all, for any temperature range — if you'll pardon our mentioning it — are B&W Insulating Firebrick.

THE BABCOCK & WILCOX CO.
Refractories Division
General Offices:
161 East 42nd St., New York 17, N. Y.
Works: Augusta, Ga. R-808

Figure 3 (above) — North or No. 2 battery shop is similar to the South shop. Note that all batteries shown are of same size for flexibility in use in trucks and of the 67 batteries in use, all but two are the same size. Figure 4 (right) — Electric truck is essential link in this integrated material handling set-up. Coils are cut into sheets in shear, dropped onto wooden pallets, rolled down gravity conveyor, picked up by electric truck for delivery to packaging section close by where pallet and sheets are wired into unit load with protecting steel angles and fibreboard covering.

With the ordinary fork-life attachment, only a few pallets could be carried successfully. A spring-loaded holding bar was designed (Figure 2) which is permanently attached to the truck, yet does not interfere with normal operation. A large load of pallets is picked up by the forks and elevated until the load pushes against the spring-tensioned bar which holds the load steady.

In Figure 4 the integration of three kinds of material handling equipment is shown. Coils of finished electrolytic tin plate are cut into sheets, dropped onto a small wooden pallet, and delivered by gravity roller conveyor to the fork-lift truck which picks up two loads at a time which are set down in the packaging area close by. Each load is secured to the pallet with steel wire, protected by steel angles and fibreboard and shipped as a unit load.

NEW MORTON COMBINATION WELDING AND TRIMMING MACHINE

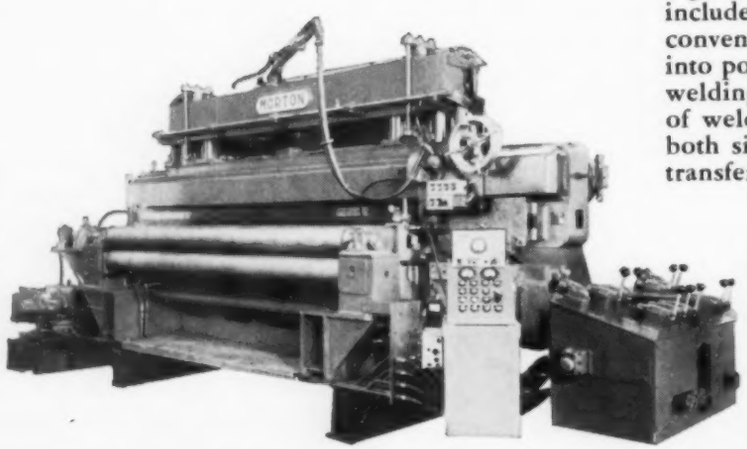


Fig. 4221. The Combined Welder and Trimmer includes all the essential features required for convenient handling of coil ends or flat sheets into position for submerged arc or gas shielded welding. It incorporates the time saving feature of welding and trimming the weld bead from both sides, at one time without unclamping or transferring the welded seam.

It is arranged for welding and trimming 10′ long seams in 1/16″ to 1/4″ stainless or other alloy sheets and strip. Pinch Rolls are furnished, the top roll being hydraulically-loaded for holding the sheet flat during welding and trimming operation. A water cooled copper back-up bar is supplied for welding operation. Any number of sheets of any width up to 10′ long can be efficiently joined to make one long sheet for your needs.

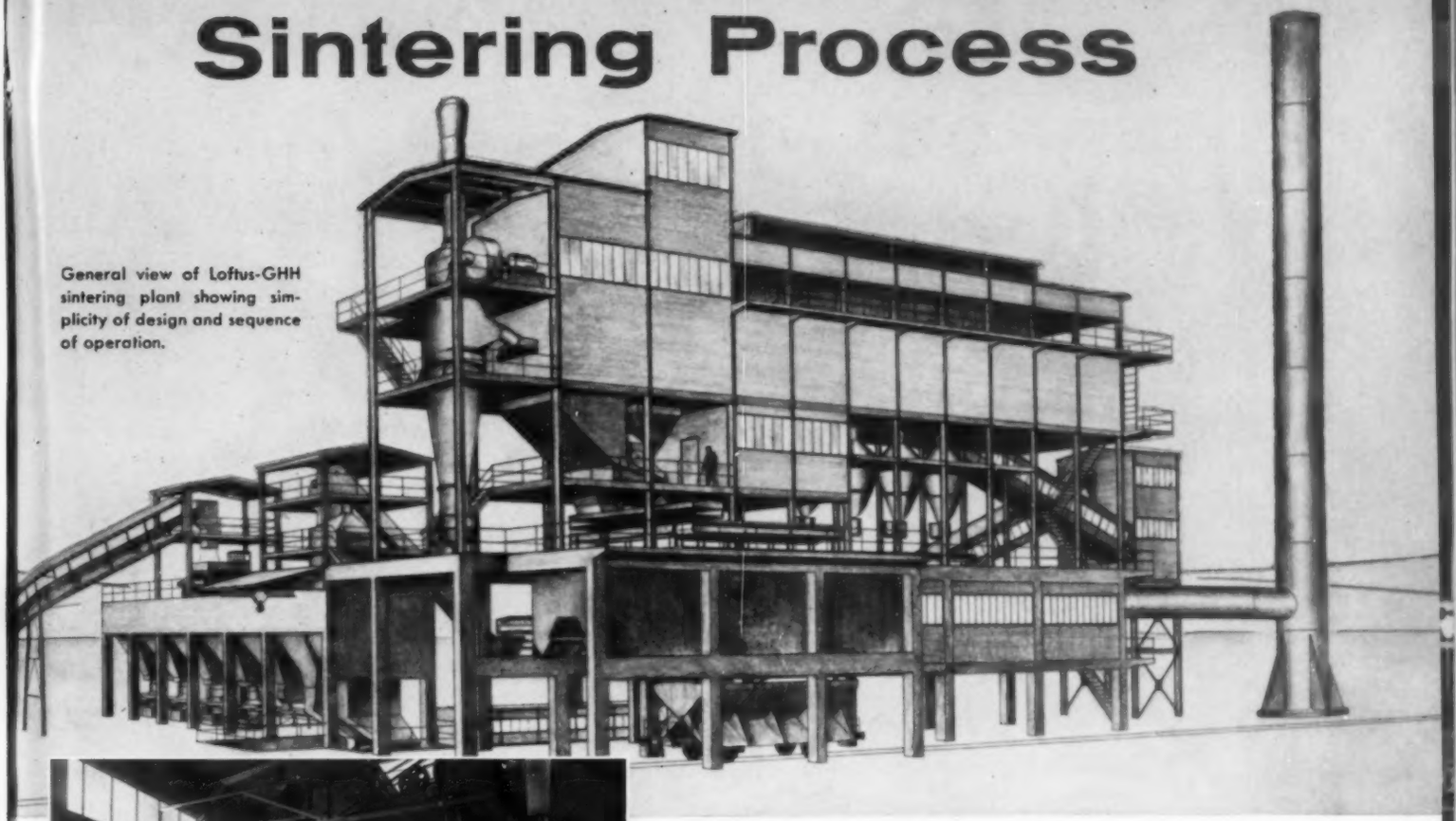
You can and will increase your Welding output with Morton Automatic Welding Machines as well as your Machine Production with Morton Machine Tools and Special Machinery.

Our New Bulletin No. 48-S shows plant-views, lists our product and some of our machine tool facilities for producing superior Machine Tools and Automatic Welding Machines. Send for your copy today.

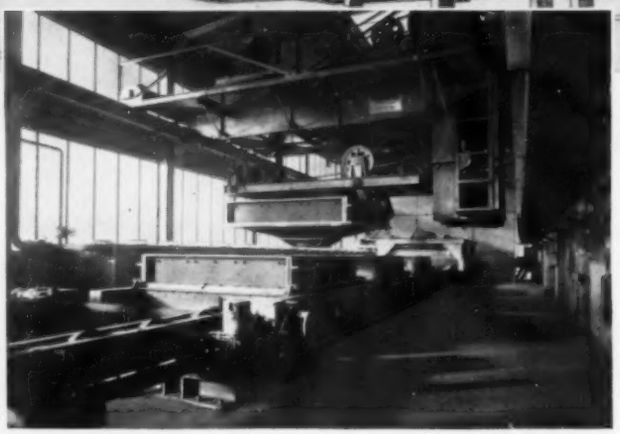
Morton Finished Machine Keys comprising Gib Head—Plain—Feather—Hi-Pro—Woodruff and Specials will assure lower assembly costs thru accuracies built into each key. A trial order will convince you.

MORTON MANUFACTURING COMPANY Muskegon Heights, Michigan

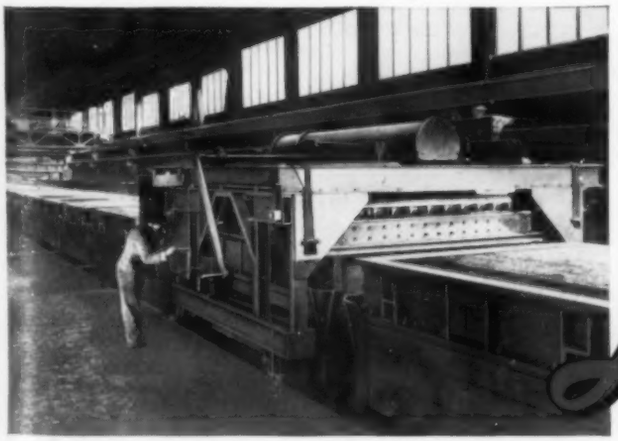
Now—An Ultra-Modern Sintering Process



General view of Loftus-GHH sintering plant showing simplicity of design and sequence of operation.



Loftus-GHH Pan sintering process obsoletes dirty sintering plants, and promotes healthful working conditions. Note the cleanliness of this plant with photo showing sintering pans and pan handling crane.



Motor driven igniter car runs on tracks, igniting the evenly distributed mix in the crane positioned pans.

CLEAN, ECONOMICAL SINTERING

...at lower overall cost

Now! Loftus introduces the GHH Sinter process to the U.S.A.

After some years of comparative observation the stationary pan process is now being repeated in three additional sintering plants in Europe, because it produces the highest quality of fully oxidized sinter *at the least cost per ton.*

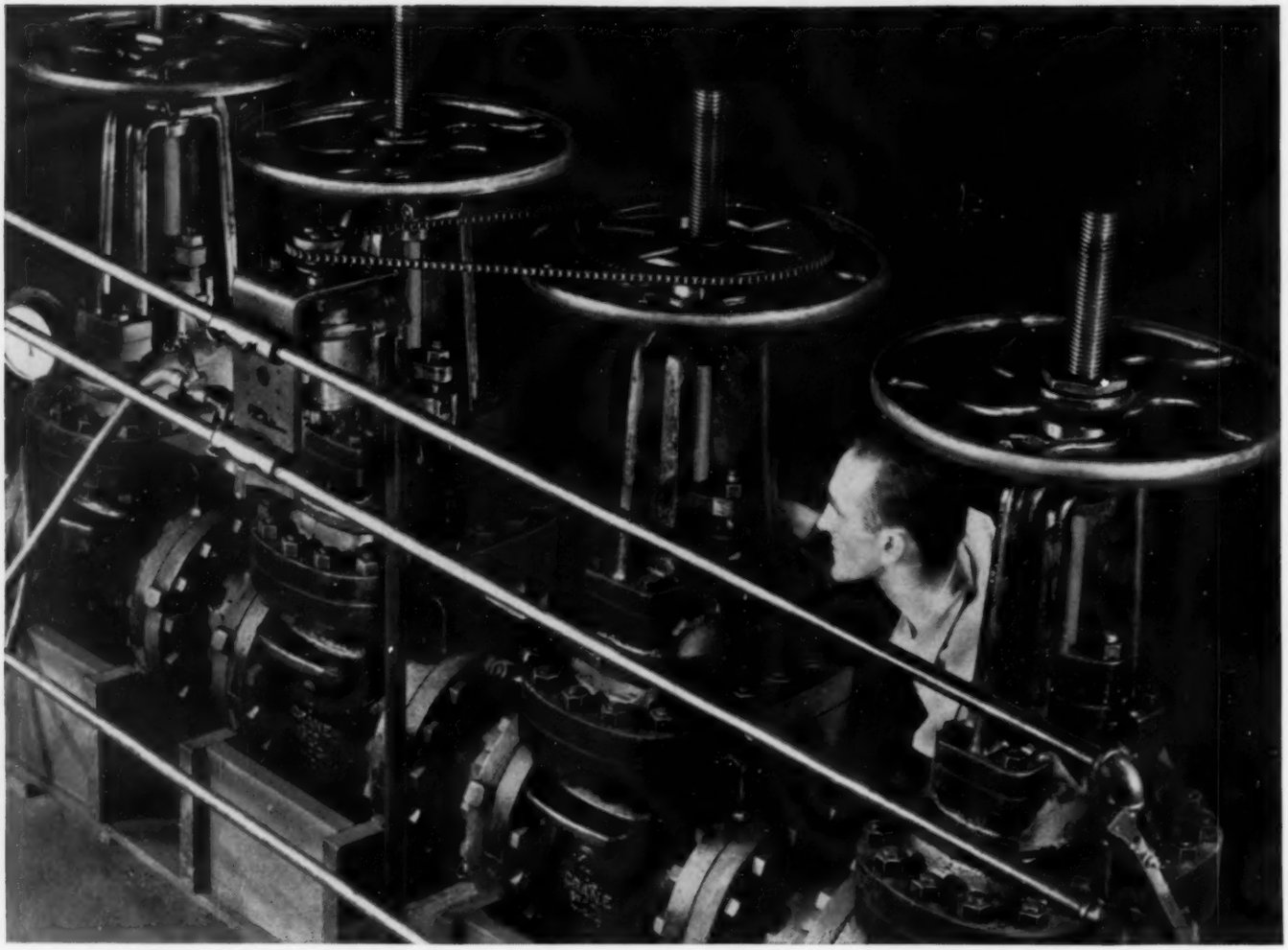
Loftus-GHH

PAN SINTERING PLANTS offer:

- **The only clean, dependable process with minimum maintenance.**
- **Lowest percentage of recirculated product.**
- **100% sintering efficiency against 80% for commonly accepted methods.**

Loftus ENGINEERING CORPORATION
Designers and Builders of Industrial Furnaces
610 Smithfield Street, Pittsburgh 22, Pennsylvania

United States Licensees of Gutehoffnungshutte (GHH) Pan Sintering Plants.



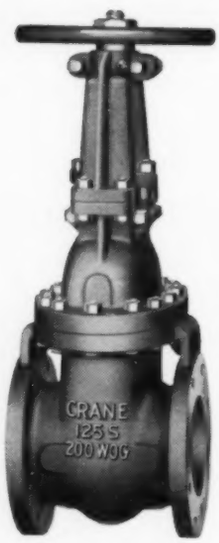
Testing...testing...50 years and longer to make CRANE VALVES maintenance free

Testing for product performance values is an old custom with Crane. It was started long before many standards existed—long before others in the field used this means of product improvement and quality control.

Today's Crane valve testing is done in both field and laboratory by the most scientific techniques. This continuing work seeks to increase valve performance and lessen maintenance needs. A single example is the stem packing test shown above.

Here's one of the reasons back of the thrifty buyers' preference for Crane valves. They can rely on ever-improving Crane quality to protect their company's investments in piping equipment—especially today, in the face of high maintenance and repair costs. No wonder industry keeps using more Crane valves than any other make.

Better Quality
Bigger Selection
in Valves
for Every Need



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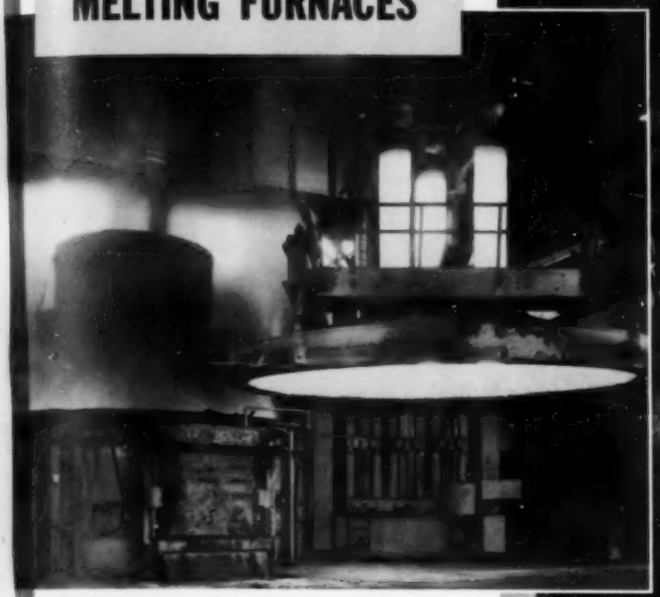
Heroult
ELECTRIC MELTING FURNACES

TOPS FOR PRODUCTION OF HIGH GRADE STAINLESS, ALLOY AND RIMMING STEELS



World's Largest Electric Furnaces

. . . now in operation!

INSTALLED in the ultra-modern mill of McLouth Steel Corporation, in Detroit, these giant *200-Ton* Heroults are the largest electric melting furnaces ever built. With an inside shell diameter of 24'6", they have a rated charge capacity of 400,000 pounds, and each is designed for efficient operation on 25,000 to 33,000 KVA transformer capacity. Featuring a swing-type roof, these furnaces are equipped with the finest, most up-to-date mechanism and electrical controls available.

McLouth's adoption of electric furnaces of this size sets a precedent. It is a "first" which should conclusively prove that, in addition to closer control, higher uniformity, better performance, and greater safety, large capacity Heroult Electric Furnaces are an economically sound investment—even for high tonnage steel-making.

We welcome an opportunity to help you select and install the furnace best suited to your particular requirements.

ASK FOR NEW CATALOGUE. *Contains latest information on modern electric furnaces—types, sizes, capacities, rating, etc. Write Pittsburgh Office for free copy.*

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GENERAL OFFICES: 525 WILLIAM PENN PLACE, PITTSBURGH, PA.

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USS

UNITED STATES STEEL

"We've got this

says Joseph Asmonga.

UNITED STATES STEEL

heat treating down cold"

U. S. Steel Heat Treater

In the entire production of steel forgings, no single operation is more important or more finicky than the heat treating. Here, with careful heating and quenching, the forging is tailor-made to the physical properties you require.

At best, heat treating is a complicated business. And when you get into the giant forgings made at our Homestead Forgings Division, you encounter problems absolutely unknown in the production of smaller forgings. Only a handful of men in this country have the skill to do the job. One of them is Joseph Asmonga, a Heat Treater for 18 of the 25 years he has been with U. S. Steel.

Sheer *size* is a great problem and often makes liquid oil or water quenching impracticable. In the photograph, Mr. Asmonga is *air* quenching a roll arbor—and it takes him 10 hours just to reduce the temperature from about 1750°F. to 650°F.

Admittedly, Mr. Asmonga has an eye-popping array of instruments, furnaces and cranes to help him—as well as a complete metallurgical staff. But when you get right down to it, it takes plain old experience and skill to change a list of specifications into a finished, precisely heat treated forging.

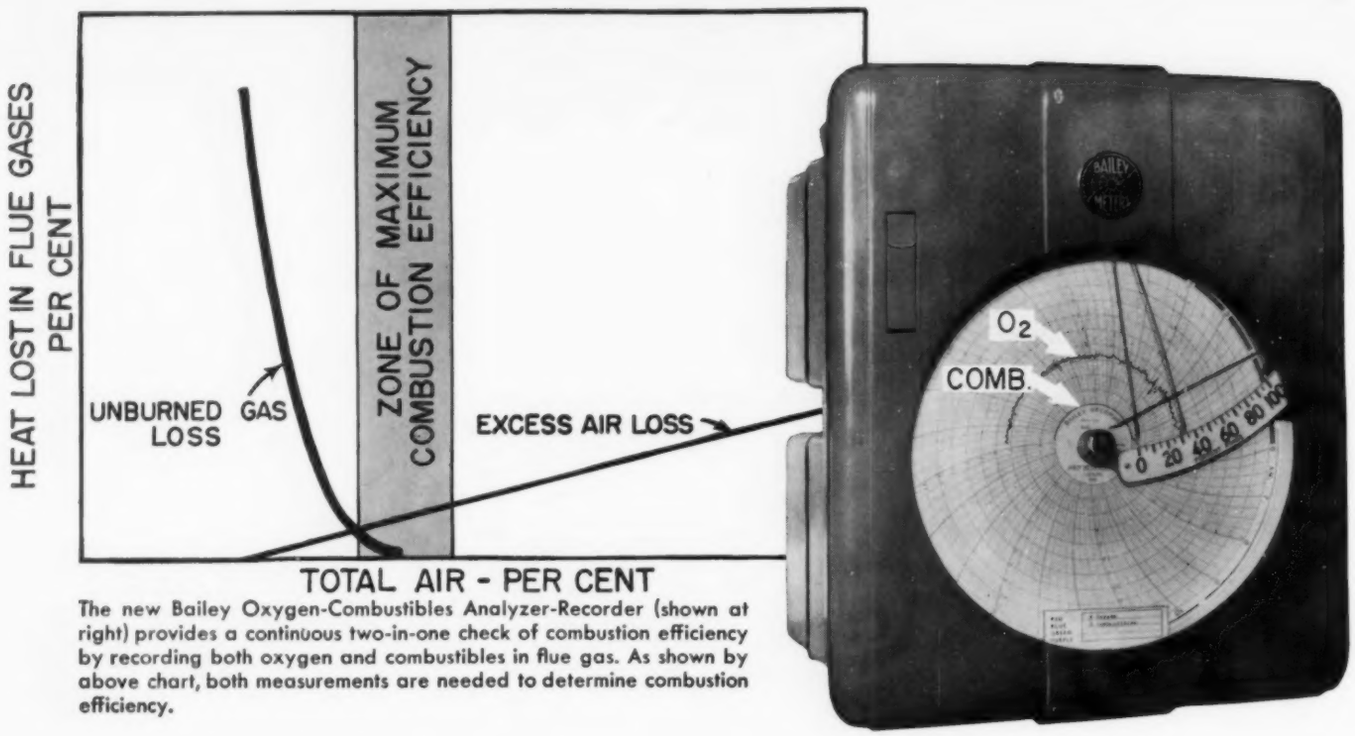
Joseph Asmonga is typical of the men who actually do the work on your U·S·S Quality Forgings. All of these men have the skill, the equipment and the *determination* to give you the finest steel forgings that money can buy. Write for more information and our free 32-page booklet describing U·S·S Quality Forgings. Address United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

USS

Quality

FORGINGS

- heavy machinery parts—carbon, alloy, stainless
- electrical and water wheel shafts
- hammer bases and columns
- forged steel rolls and back-up roll sleeves



The new Bailey Oxygen-Combustibles Analyzer-Recorder (shown at right) provides a continuous two-in-one check of combustion efficiency by recording both oxygen and combustibles in flue gas. As shown by above chart, both measurements are needed to determine combustion efficiency.

BAILEY announces · · · New 2 in 1 way to measure Combustion Efficiency

The new Bailey Oxygen-Combustibles Analyzer-Recorder gives you a continuing double check on combustion economy. It's fast response measures and records:

1. Excess air—regardless of the fuel or combinations of fuels being burned.

2. The mixing efficiency of your fuel-burning equipment—by indicating the amount of combustibles in your flue gas, resulting from incomplete mixing of fuel and air.

Combustion efficiency depends upon fuel-air ratio. Too much fuel can be even more costly than too much air. And because of the interdependence of these two factors, no control that measures only one of them can give you complete protection.

Now, for the first time, you can check *both* with a *single* fast acting instrument, using the new Bailey Oxygen-Combustibles Analyzer-Recorder for industrial furnaces, kilns, heaters and boilers.

Fuel economy improves as excess air is reduced —until unburned fuel begins to show up in the flue gas. When this happens, combustion efficiency drops off sharply if there are further decreases in the air-fuel ratio. That's why combustion gases must be analyzed for *both* oxygen and combustibles to get a true indication of efficiency—and that is why Bailey coordinates both measurements on the same chart, to show when excess air may be reduced safely without danger of greater losses from unburned gases.

The Bailey Oxygen-Combustibles Analyzer is an approved combustion safeguard.

Ask your local Bailey engineer for suggestions on application. Equipment details in Product Specifications E65-1 and E12-5. P31-1

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INSTRUMENTS AND CONTROLS

For Power And Process

Big and "little" friends: 26,000 and 10,000 lb. trucks

Save more money by handling bigger loads

—with the world's largest standard lift truck—26,000 lbs.

The Clark-Ross Y-260 will handle bigger outdoor loads than any other lift truck, and it will go places where no other lift truck can travel! This truck is big enough to handle jobs which formerly required a crane and operator, hook man and trucker. It has the utmost traction and flotation—huge 14.00 x 20 tires are standard front and rear, with excellent weight distribution and 9 in. minimum underclearance. Its 17½ ft. turning radius permits it to be used in yards laid out for smaller trucks.

This Y-260 is *built* for 26,000 lbs. (at 36 inches)—not just beefed-up. It's as easy to drive as a truck half its size; power steering and power brakes are standard. And a brake selection switch enables the driver to apply brakes to *either* drive wheel, when one wheel has lost traction in slippery grounds. Maintenance access is excellent, wrap-around counterweight has minimum over-hang, operator visibility is outstanding. In general, *this lift truck is a beautiful brute!*

For big jobs, you'll want more details on the Y-260. Call your local Clark dealer, listed in the Yellow Pages under "Trucks, Industrial," or send the coupon.

CLARK EQUIPMENT

Industrial Truck Division
Battle Creek 135, Michigan

Send details on Y-260

Name_____

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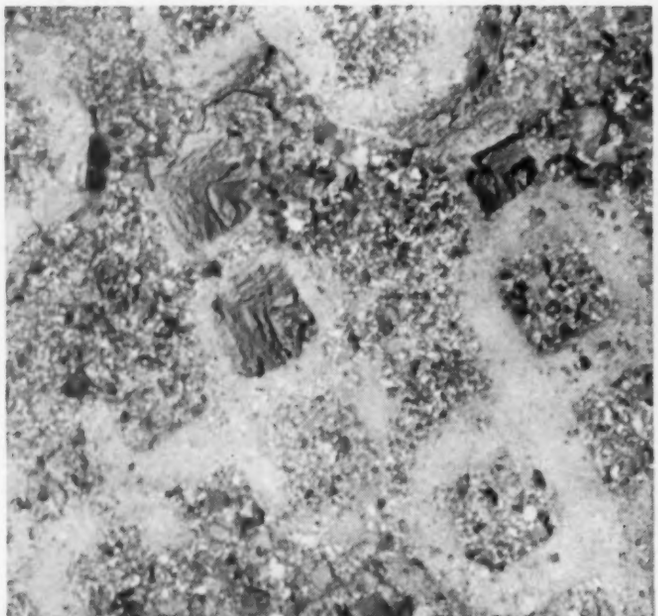
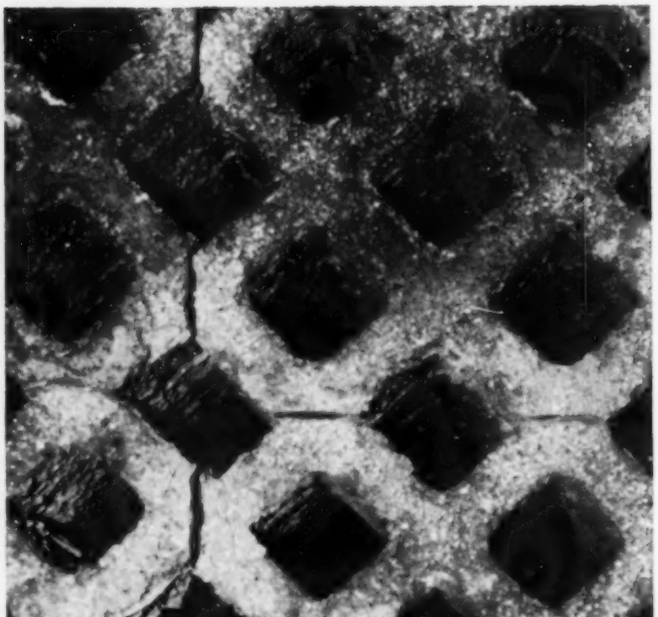
Address_____

City_____



BEFORE



AFTER

BLAST FURNACE STOVE CLEANED QUICKLY WITH CHEMICALS

Total outage was only 10 days on 3400-checker unit

The desired dome temperature of 2000° F. could not be obtained on this blast furnace stove because of plugged checkers. Maximum temperature reached was 1700° F. This reading dropped below 1100° F. within an hour after the stove was put on furnace. Cleaning was imperative.

Dowell engineers applied chemical solvents using high-pressure jet lances. All 3400 of the checker passages were opened and restored to full effectiveness in just 50 hours. Total outage was only 10 days—about half the time normally required when other methods of cleaning were used.

Checkers of even the smallest size—square or round, with ball or star inserts—have been cleaned quickly and effectively without breaking, using Dowell chemical solvents. The Dowell method is designed to clean corners and other surfaces inaccessible to mechanical means.

For complete information on chemical cleaning of blast furnace gas cycle equipment, boilers, towers, heat exchangers, lines, water wells—call the nearest of over 130 Dowell offices. Or write directly to DOWELL INCORPORATED, Tulsa 1, Oklahoma, Dept. A-29.

DOWELL SERVICE

chemical cleaning services for industry

DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

Date-line Diary...

December 1

▲ The F. W. Dodge Corp. reported that 1954 has already set a new all-time record for construction contract awards in the 37 eastern states with November bringing the 11 month total to $17,941,370,000 which was above the figure for the entire year of 1953. The November awards totaled $1,498,850,000, almost 8 per cent above November 1953.

December 2

▲ Due to sharp reductions in Government's supply of copper, all copper allocations to industry will be cut. At present, only 7603 tons of copper are available for emergency distribution to copper users through December.

December 3

▲ The Labor Secretary reported that 1,300,000 jobless workers had used up their unemployment rights during the first nine months of 1954 without locating jobs. This was more than double the amount of such cases in the like period in 1953.

December 6

▲ The total estimated payroll of the iron and steel industry for October was $244,698,000 the highest for any month since March, reported the AISI. The estimated payroll for the first 10 months of 1954 was $2,393,266,000 the second highest in history for that period exceeded only by 1953. The average hourly payroll cost of wage earners was $2.364 during October compared to $2.307 in October 1953. An average of 596,100 workers averaged 36.6 hours a week in October.

▲ The Chicago Mercantile Exchange has authorized the addition of futures contracts for No. 2 heavy melting steel scrap to those now being traded. New contracts will call for delivery of the No. 2 grade at par if the original transaction was made in that grade.

▲ Unemployment claims for compensation filed in the week ending November 27 were below a year ago for the third consecutive week, falling to 241,000 or 38,000 below the like period in 1953.

▲ The AISI reports that operating rate of the steel industry for the week of December 6 is scheduled at 81.5 per cent of capacity. This is equivalent to 1,944,000 tons compared with 1,941,000 tons one week ago and 1,955,000 tons one year ago. Index of production for the week is 121.0.

December 7

▲ Secretary of Treasury, Humphrey, stated the budget for the fiscal year ending June 30, 1955 could not be balanced, and indicated the department was trying to do better than the $3,000,000,000 deficit last June 30.

▲ October shipments of finished steel products increased to 5,035,000 net tons in October, the highest since June, according to the AISI, thus bringing the total for the first ten months of 1954 to 52,485,000 tons compared with 68,599,000 tons for the first ten months of 1953.

December 8

▲ Construction outlays in November were $3,300,000,000, 8 per cent above the same month in 1953 but 6 per cent below October 1954.

December 9

▲ General Motors Corp. has announced that it plans to spend $9,000,000 in 1955 on expansion in France, Sweden, Denmark and England.

▲ U. S. Dept. of Commerce reported exports of commercial goods in October totaled $1,169,000,000 up $194,000,000 from September. October imports dropped $17,000,000 from September to $764,000,000 in October.

▲ The U. S. Dept. of Interior reported that consumption of ferrous scrap during October totaled 4,786,000 gross tons, an increase of 12 per cent over September's total of 4,298,495 gross tons. Of this 2,625,000 tons was home scrap.

▲ The Aluminum Association reported production of primary aluminum in October 1954 totaled 250,178,989 lb as compared with 240,664,643 lb in the previous month and 216,438,214 lb in October one year ago.

December 10

▲ Climax Molybdenum Co. announced an increase in price of molybdic oxide of about 10 per cent thus bringing the present price to $1.25 per lb.

▲ U. S. Steel Corp. announced a slight increase of less than an average of two per cent in its prices for nickel bearing grades of stainless steels and certain grades of alloy steel containing nickel. The revision in price is a result of the recent advance in cost of primary nickel.

Rail freight loadings totaled 661,797 cars for the week of November 29 and 78,282 cars over the previous week. The figure was 229 cars below the corresponding period in 1953.

▲ According to the Commerce Dept., October stocks of manufacturers, wholesalers and retailers were valued at $77,900,000,000, $400,000,000 above the preceding month and $4,400,000,000 below the figure for October 1953.

▲ Production of Canadian pig iron in November amounted to 211,478 tons compared with 254,643 tons produced in 1953.

December 13

▲ House speaker, Martin, urged Congress to continue the corporate and excise tax rates at existing rates. Present law slated a drop in corporate income tax from 52 to 47 per cent effective April 1.

▲ The AISI reports that operating rate of the steel industry for the week of December 13 is scheduled at 81.5 per cent of capacity, the same as the previous week's schedule. This is equivalent to 1,944,000 tons compared with 1,958,000 tons one week ago and 1,900,000 tons one year ago. Index of production for the week is 121.0.

December 14

▲ Scrap and pig iron consumed during 1953 totaled 151,838,246 tons, a 16 per cent gain over the 130,574,085 tons consumed in 1952, according to the Mineral Industry Surveys of the U. S. Dept. of Interior, Bureau of Mines.

December 15

▲ The Electro Metallurgical Co. Div. of Union Carbide and Carbon Corp., announced a reduction of $4 per net ton in carload bulk price of all briquetted alloys.

▲ Employment in the steel industry has improved substantially in the past few weeks according to president of the CIO Steelworkers, David J. McDonald. The number of unemployed union members has been reduced to 180,000 compared with the 212,000

unemployed in August and the 201,000 unemployed on October 31.

December 16

▲ Industrial production in November equaled the corresponding month the previous year for the first time in 1954.

▲ General Electric Co.'s total sales for 1954 will be around 5 per cent below the figure of $3,128,000,000 for 1953 according to Ralph J. Cordiner, president.

▲ Republic Steel Corp. expects to set new iron and steel production records at its Warren, Ohio plant in 1955. Production in the open hearth dept. in 1953 totaled 924,751 net tons and will be an approximate 975,000 tons in 1954. Blast furnace production amounted to 574,028 net tons of pig iron in 1953 and will be an approximate 600,000 tons or over in 1954.

▲ National Steel Corp. announced their price differential of 15 cents per 100 lb above the Pittsburgh base in the Detroit area has been reduced to 10 cents per 100 lb.

December 17

▲ Carloadings last week were ahead of the corresponding week last year for the first time this year with 653,531 cars.

▲ Home building in November set a new high for the month, according to the Labor Dept., with starts on 103,000 units, a 26 per cent rise over November 1953.

December 19

▲ Deliveries of new domestic freight cars in November 1954 totaled 1302 compared with 1817 in October and 6137 in November 1953 according to the ARCI. Sales in November totaled 3754 cars leaving a backlog of cars on order as of December 1, 1954 of 14,805 compared with 12,853 on November 1.

December 20

▲ The NLRB formally decided that "hot cargo" clauses in union contracts are valid.

▲ The AISI reports that operating rate of the steel industry for the week of December 20 is scheduled at 73.6 per cent of capacity. This is equivalent to 1,756,000 tons compared with 1,950,000 tons one week ago and 1,444,000 tons one year ago. Index of production for the week is 109.3.

December 21

▲ The Agriculture Dept. predicts that winter wheat output in 1955 will decline to 679,000,000 bushels, off 14 per cent from the 1954 crop. This cut reflects to the cutbacks in winter wheat seeding this fall.

▲ Capital outlays of manufacturing firms from 1946 through mid-1954 reached $115,000,000,000. This expenditure was far greater than any previous comparable period. However, despite big spending, the net cash position of these companies had increased $2,000,000,000.

December 22

▲ Steel scrap prices advanced $1 a ton in Chicago. Two consumers purchased No. 2 heavy melting scrap at $32 a ton and the No. 1 dealer bundles at $34.

▲ According to the International Nickel Co. of Canada, nickel production will reach a record 390,000,000 lb this year and will climb to 415,000,000 lb in 1955.

▲ Earle V. Grover, president of the AISC and Apex Steel Corp., Ltd., predicts an equal production of fabricated structural steel in 1955 as compared to shipments of such in 1954. Shipments for 1954 totaled about 3,200,000 tons compared with 3,117,711 tons in 1953. Bookings in 1954 totaled about 2,500,000 tons.

December 23

▲ Crucible Steel Co. of America reports an increase in price of nickel and molybdenum plus new prices on stainless steels reflecting increased production costs. Increases ranged from ½ to 3½ cents per lb.

▲ W. J. Holliday and Co., Inc. announced the sale of its steel warehouse business in Indianapolis and Hammond, Ind. to Jones and Laughlin Steel Corp. of Pittsburgh, Pa.

▲ U. S. steel production in 1955 will surpass its 1954 output by 7,500,000 tons, C. M. White, president of Republic Steel Corp., predicts.

December 24

▲ Ford Motor Co. proclaimed itself the winner in its sales race with Chevrolet in 1954.

▲ The Commerce Dept. reported a 4 per cent increase in exports of commercial goods, or $10,400,000,000 during the first ten months of 1954 over the like 1953 period. However, a decline of 8 per cent in imports of foreign products to $8,400,000,000 was felt.

December 27

▲ DeWitt C. Ramsey, president of the Aircraft Industries Association, forecasts a decline of aircraft sales in 1955 to around $8,000,000,000 from the $8,600,000,000 in 1954.

▲ Earnings from railroad operations fell 33 per cent in 1954, according to the AAR.

▲ The AISI reports that operating rate of the steel industry for the week of December 27 is scheduled at 77.4 per cent of capacity. This is equivalent to 1,846,000 tons compared with 1,726,000 tons one week ago and 1,706,000 tons one year ago. Index of production for the week is 114.9.

▲ The AISC reports November bookings of fabricated structural steel amounted to 193,405 tons as compared to 153,514 tons in November 1953 and 212,419 tons in October 1954. Shipments in November totaled 226,496 tons leaving a backlog of work ahead as of November 30 of 1,280,348 tons.

▲ Machine tool orders dropped to a 4½ year low in November. New orders for 1954 are estimated at $535,000,000, down 38 per cent from 1953.

December 28

▲ The U. S. will ask bids on a $26,000,000 engineering and foundry plant at New Castle, Pa. It includes 15 buildings on 50 acres, and was built and financed by the Defense Plants Corp. during World War II. It has been operated by United Engineering and Foundry Co.

December 29

▲ Farm price support losses of the Government may climb to a record $750,000,000 for the year ending next June 30 compared to $420,000,000 set in 1954.

▲ Atomic Energy Commission reports negotiations on $60,000,000 of new contracts for the expansion of atomic plants near St. Louis and Fernald, Ohio.

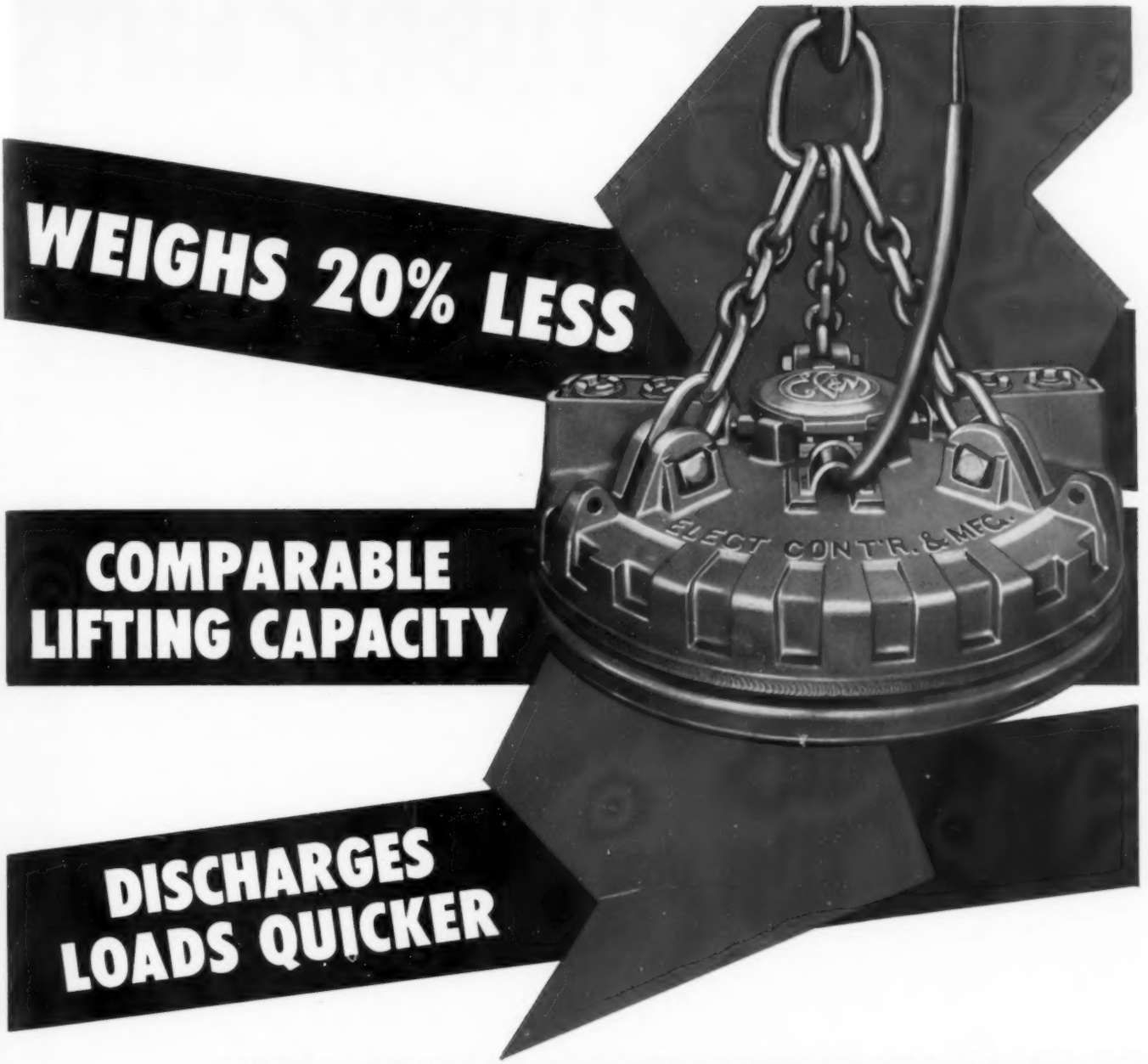
December 30

▲ Dow-Jones climbed above 400 to 401.97 for the first time.

▲ Ford Motor Co. earnings, before taxes were allowed, were off 5 to 6 per cent from 1953, but net profits are up as a result of the expiration of the excess profits tax.

December 31

▲ Steel scrap prices rose sharply in Pittsburgh as No. 1 heavy melting scrap went up $3.50 a ton, No. 2 heavy melting scrap took a similar gain, while No. 2 bundles were up $1.50 a ton. Chicago showed similar like gains.



NEW 45" MAGNET PROVIDES FASTER OPERATION OVER A WIDER WORKING RADIUS

This new magnet, developed by EC&M engineers, is the lightest weight magnet in the 45-inch size. High strength and watertight construction is maintained with a completely ALL-WELDED design. Elimination of bolt-head recesses allows a better proportion for coil space, giving high lifting capacity. Welding keeps pole shoes tight too. Get the facts on this new EC&M type LSW magnet. Operators like the faster maneuverability . . . greater working radius, which permits more trips per day. The EC&M complete line of magnets includes 14 sizes, from 12-inches to 80-inches in diameter (the world's largest).

Write for Bulletin 900-L

6101

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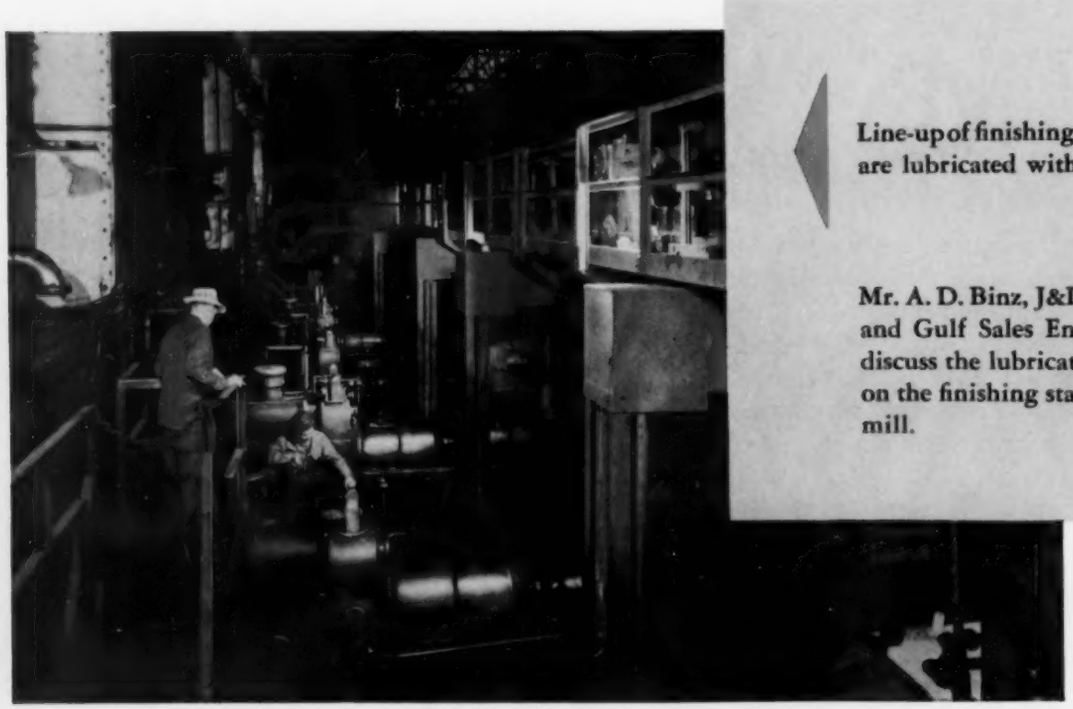
GULF E. P. LUBRICANTS provide *protection plus* on Jones & Laughlin's

Protection plus means that in addition to their extra load carrying capacity, their ability to stick to gear teeth and prevent scoring and welding, Gulf E.P. Lubricants have other advantages that help Jones & Laughlin and many other steel companies get effective lubrication and lower maintenance costs.

They have excellent water separating and rust preventive properties, exceptional stability for this type of lubricant, and effective nonfoaming and noncorrosive characteristics. And because of Gulf E.P. Lubricants' superior film strength, it is often possible to reduce the number of lubricants needed and simplify your lubricant storage and handling.

When you next order gear drive lubricants, make it an order for safe, sure protection and lower maintenance costs—specify Gulf E.P. Lubricants.

For expert help on any lubrication problem, call in a Gulf Sales Engineer. You will find him always on call at your nearest Gulf office.



Line-up of finishing train pinion stands. All are lubricated with Gulf E.P. Lubricants.

Mr. A. D. Binz, J&L Lubrication Engineer, and Gulf Sales Engineer C. D. Gilchrist discuss the lubrication of the mill pinions on the finishing stands of the 96" hot strip mill.

for mill pinions 96" hot strip mill

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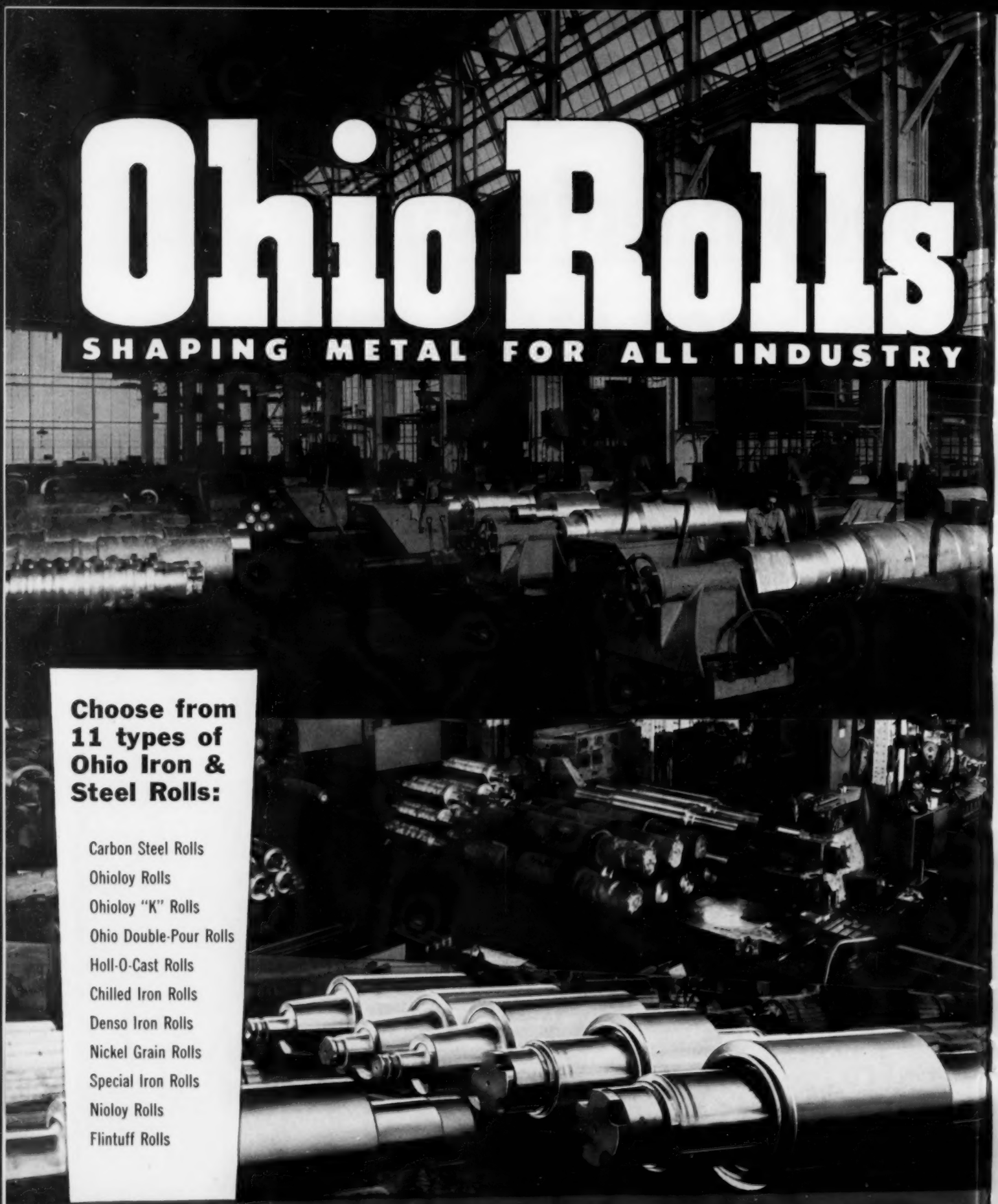

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Industry News...

NATIONAL TUBE DIVISION ANNOUNCES EXPANSION PROGRAM FOR McKEESPORT AND LORAIN WORKS

▲ J. E. Goble, president of National Tube Division of United States Steel Corp. announced an expansion program to increase production of oil country tubular products and to meet future requirements of the oil industry.

Work is scheduled to start immediately on facilities designed to triple the division's production of deep-well casing at National Works in McKeesport, Pa. This pipe, a 110,000 lb minimum-yield strength casing, is being used in increasingly larger proportions in the oil industry.

In order to increase the production of this high strength pipe, additional equipment will be installed for treating and finishing the pipe in the seamless pipe mills. The new equipment is expected to be in production in about a year.

At the same time, Mr. Goble announced that work would start immediately at National Tube's Lorain Works in Lorain, Ohio, on the addition of new upsetting units to increase production of external upset API tubing in the 2⅜ to 4½ in. outside diameter range. This process increases the wall thickness at the end of the pipe which permits the threaded end to be as strong as the body of the pipe.

COMPLETION NEAR ON NEW PILOT PLANT

▲ Battelle Institute's first units of an expanded program of pilot-plant and large-scale research facilities at the recently-purchased 400-acre site just outside Columbus, Ohio, will be ready for installation of equipment in the next 30 days.

The new facilities, will be used primarily for large-scale studies in chemical engineering, metallurgy, and minerals processing, according to Clyde Williams, Battelle's president and director.

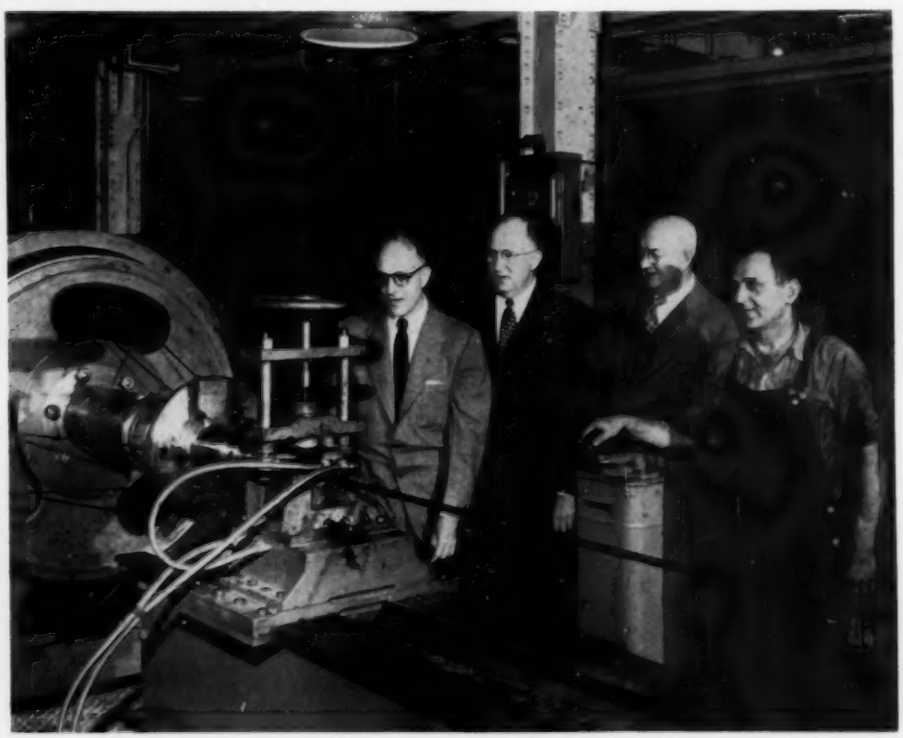
Provided initially in the $300,000 construction program are two major buildings, totaling 13,000 sq ft and designed specifically for large-scale experimental work. Ample water, natural gas, and electric power have been provided to meet any foreseeable pilot-plant need. Additional buildings are contemplated and will be custom built to fill specific industry needs as they arise.

The new laboratories will house extensive chemical engineering equipment. Also being installed is a 500-kva, 3-phase transformer, equipped with automatic controls, which can be used with a 1000 lb melting furnace or for studies of continuous smelting.

Much of Battelle's expanded pilot-plant research will be guided by John W. Clegg, Manager, Department of Chemical Engineering; J. Harry Jackson, Manager, Department of Metallurgy, and W. H. Browne, Manager, Department of Mechanical Engineering. All have been closely associated with the Institute's already extensive large-scale experimental studies.

INSTALL HIGH-SPEED MACHINE FOR WIRE ROPE

This new high-speed tube closing machine which will produce wire rope at the rate of 6000 and more ft per hr, was recently installed at the American Chain & Cable Co., Wilkes-Barre, Pa. Company officials, left to right, E. H. Todd, sales manager wire rope divisions; E. S. Wellhofer, assistant plant manager, and G. C. Gregson, plant manager, watch as operator throws switch at starting ceremonies.



BUFFALO BLAST FURNACE SETS MONTHLY RECORD

▲ All monthly pig iron production records for Republic Steel Corp.'s No. 2 Buffalo blast furnace were shattered during December when 35,834 tons were produced, according to Charles W. Barrett, manager of the Buffalo steel plant.

The December effort marked the second consecutive month of record output. In November, the Republic blast furnace, the larger of two operated at the local plant, turned out 34,415 tons of pig iron, best since 33,081 tons had been produced 20 months earlier in March, 1953.

Mr. Barrett credited the record production of the No. 2 blast furnace to top-pressure blowing for which

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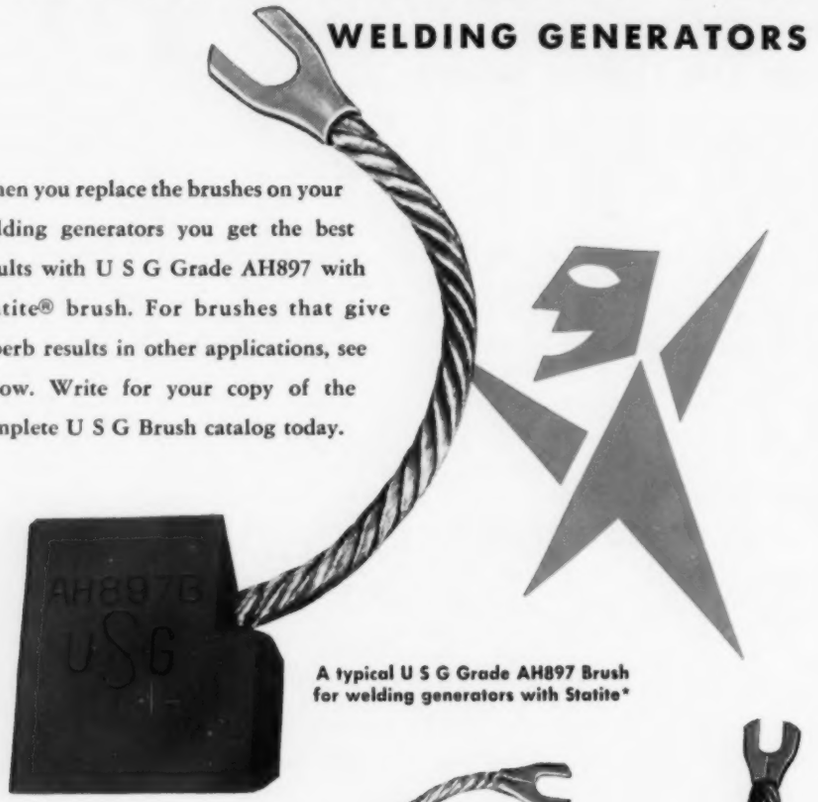
When you replace the brushes on your welding generators you get the best results with U S G Grade AH897 with Statite® brush. For brushes that give superb results in other applications, see below. Write for your copy of the complete U S G Brush catalog today.



A typical U S G Grade AH897 Brush for welding generators with Statite*

U S G Grade 1658 Brush for tin line collector rolls

U S G Grade 135 Mill Motor Brush with Statite*

U S G Grade 223 Brush for DC crane motors with Statite*

U S G Grade 550 Brush for AC Crane Motor Rings

197

*Permanent shunt connection, needing no hammerclips; cannot be jarred loose or pulled out.

THE UNITED STATES GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN

the furnace was equipped six years ago. The Buffalo unit is one of seven so equipped throughout the company.

Before top-pressure blowing was installed on No. 2 furnace, the production record had been 32,557 tons of pig iron, a mark reached in March, 1947.

Republic's No. 2 furnace has a rated daily capacity of 1,070 tons of pig iron. The company's other blast furnace there has a daily capacity of 710 tons.

GE REVISES DISCOUNT STRUCTURE ON MOTORS

▲ A major revision of its marketing discount structure on polyphase induction motors in the 1- to 200-hp range has been announced by General Electric Co.

Purchaser discounts have been revised to lower net prices an average of approximately six per cent, resulting in a more realistic relationship between the various channels of distribution. One phase of this realignment will extend distributor coverage of standard motor lines in the 1- to 200-hp range.

As an example of the change, basic user discounts on the 7½ to 200-hp motors have been increased to 49 per cent from the former range of 40 to 45 per cent, while quantity discounts have been increased up to 55 per cent from the former 48 per cent.

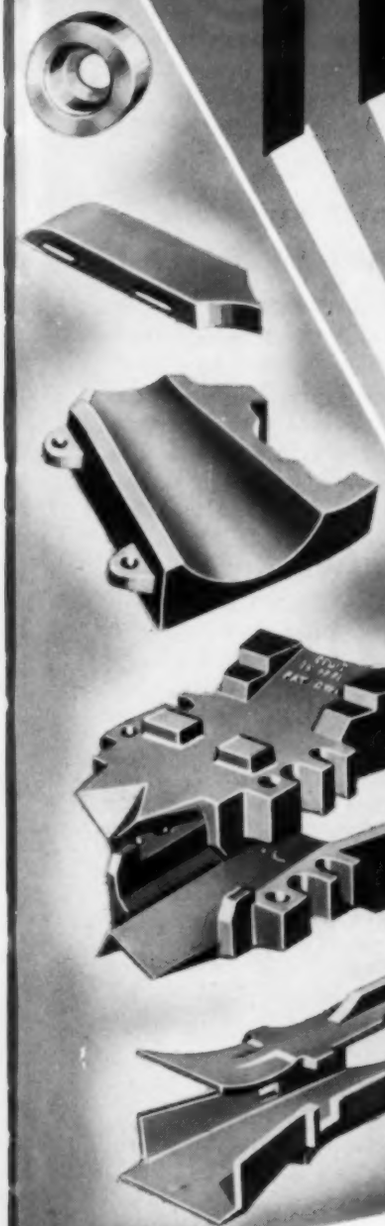
Also announced are two changes in book prices. Book prices for the ten most popular ratings of 4-pole Tri-Clad 55 induction motors in the 1- to 5-hp range have been reduced by five per cent, while book prices for motors in the 40- to 200-hp range have been adjusted upward by five per cent. In both bases, the result is a decrease in net price.

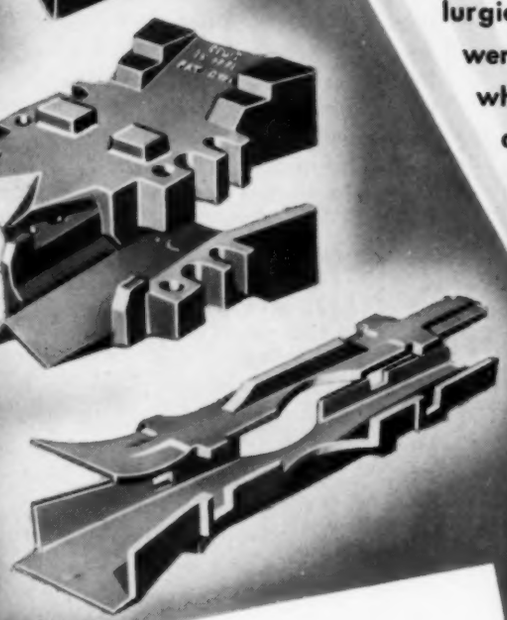
FORM NEW ENGLAND STEEL CORPORATION

▲ Northeastern Steel Corp., a new company, was incorporated to make hot rolled specialty steels for the New England area. The corporation will acquire the present steel strip plant of the Stanley Works, Bridgeport, Conn. Ingot capacity will increase from the present 188,000 tons to 300,000 tons a year.

Modern electric furnaces will be added to the present open hearth

TRANTINYL GUIDES THE STEEL INDUSTRY





"TRANTINYL" offers a quarter-century of metallurgical experience. "TRANTINYL" patented alloys were developed to function in specific operations where guides are required to resist wear and abrasion. Users of "TRANTINYL" alloys are astounded at the tonnage rolled over one set of guides.

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ROLLING MILLS:
bar, hoop, strip, shape mill guides; and rollers.

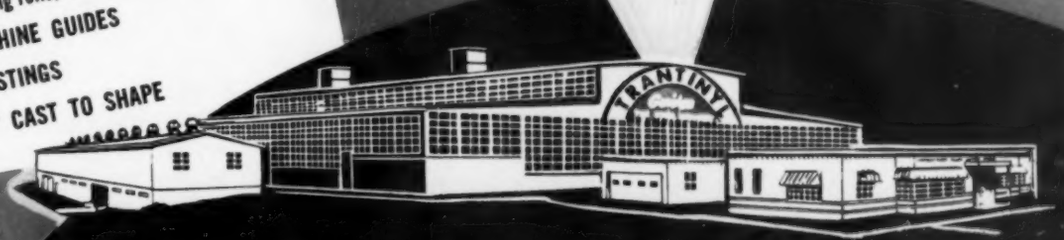
SEAMLESS TUBE MILLS:
guide shoes, rolling mill plugs and rolls, piercer points, etc.

ELECTRIC WELD TUBE MILL:
forming rolls, planishing rolls, tool holders, etc.

STRAIGHTENING MACHINE GUIDES

HEAT RESISTING CASTINGS

"TRANTINYL No. 1" CAST TO SHAPE



Youngstown Alloy Casting Corporation

Youngstown, Ohio

G-10

fast * sure * safe *

* three ways to describe Salem-Brosius clay guns in operation at the blast furnace tap hole. For more than three decades our engineers have diligently applied their experience to the design and production of efficient low-cost guns. That's why so many Salem-Brosius guns have been working so long—so well. Available mechanical, hydraulic, or steam—pedestal or column mounted. For fast, sure, safe guns—please write to us.

SALEM-BROSIUS, INC.

2400 East Carson St. • Pittsburgh 3, Pa.
In Canada: Salem Engineering Ltd.
1525 Bloor Street West • Toronto 9, Ontario

operation and products will be diversified by conversion of part of the present facilities to production of carbon and alloy bars. No blast furnace will be required by the new mill since the company will use scrap.

Walter P. Jacobs, chairman and chief executive of Northeastern, announced that the present employe force of the Stanley Works will be retained by the new company, and the total work force should be enlarged as operations expand in line with present plans.

KAISER PLANS ADDITION TO FONTANA WAREHOUSE

▲ Plans for a major addition to its mill warehousing facilities at Fontana, Calif., have been announced by Kaiser Steel Corp. Construction of a $1,150,000 structural steel building for pipe and structural shapes has been authorized.

Better service to western jobbers, manufacturers, contractors, and carload customers will be made possible by this latest expansion. Diversified requirements of different customers will be met more rapidly by drawing from stock, thus extending an important service feature.

Engineering is already underway, and construction will start early in 1955.

ANNOUNCE BRUNSWICK MANGANESE DISCOVERY

▲ A new manganese discovery in New Brunswick which will be of help to North American supply particularly in time of war has been announced. Strategic Materials Corp. has mapped out a deposit of at least 150,000,000 tons of manganese ore at Woodstock, New Brunswick, close to the Maine border. Full extent of the reserves is still to be charted.

Although this is a low grade 10 per cent ore, several unusual factors may make it an economical and competitive producer. One of these is the fact that the ore is magnetic in a non-magnetic gangue. As a result of a simple magnetic operation, the manganese concentration can be doubled.

In addition, discovery of a large deposit of pyrites, which is a rich sulphur-bearing rock, has been discovered in New Brunswick not too far from the manganese deposit.

Since the sulphur-leach process is one of the best for ore concentration, this second deposit will enable the producer to further produce the ores more economically.

Plans are under way to have a mill built which will produce ore within one year. An initial output of 320 tons of manganese a day or 1/7 of United States consumption is planned.

TO OPERATE SUBSIDIARY AS COMPANY DIVISION

▲ Consolidated Machine Tool Corp., wholly-owned subsidiary of Farrel-Birmingham Co., Inc., has been dissolved as a separate corporation and its business and activities will be conducted as a division of the parent corporation.

The new division will be operated as Consolidated Machine Tool Co., a division of Farrel-Birmingham Co., Inc. Activities will continue in the Rochester division as before and management will remain the same.

Farrel-Birmingham acquired Consolidated as a wholly-owned subsidiary December 1951 by purchase of the common stock from its former owner, the late Arthur H. Ingle. Mr. Ingle had formed the Consolidated Corp. in 1922 by merging the interests of several well known machine tool builders.

CARBORUNDUM SETS UP NEW OPERATING DIVISION

▲ A new operating unit, the Electro Minerals Division, has been established by the Carborundum Co. to manufacture and sell silicon carbide and fused alumina crudes, abrasive grain and related electric furnace products in the United States. In making the announcement, General Clinton F. Robinson, president of the firm, said that Joseph S. Imirie, formerly assistant to the president, will be general manager of the new division.

The large Bonded Products and Grain Division in Niagara Falls N. Y., which formerly encompassed the responsibilities now allocated to the Electro Minerals Division, will be designated the Bonded Abrasives Division and will specialize in the manufacture and sale of grinding wheels, sharpening stones and other bonded abrasives, which include over 30,000 standard products each year.

New, improved Taylor Made

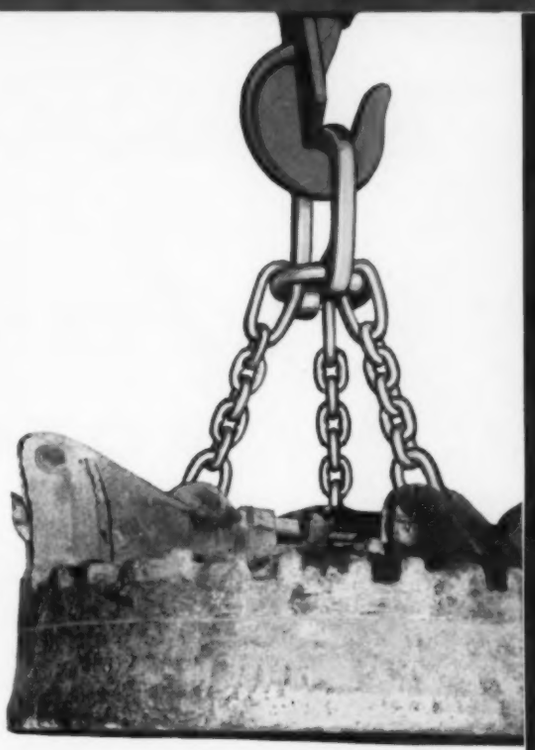
ALLOY STEEL

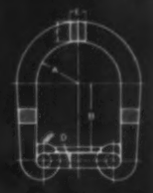
DOWNTOWN TYPE

MAGNET CHAIN

lasts 5 to 15 times longer

than conventional three-leg types!





New Lifting Bail Design

provides larger opening for crane hook. Heavy, squared-type Alloy Steel construction assures longer life.

Locating Plate

takes larger joiner links with squared top sections—keeps chain legs at 120° centers to reduce wear due to friction, twisting and gouging.

Patent No. 2626175

Designed to eliminate wear due to twisting—reduces the lifting angle and therefore increases the strength and life of chain. Made with Taylor Made Alloy Steel Chain, it has twice the strength of wrought iron assemblies. It's tougher too! Heat-treated—it has great resistance to shock lifts, grain-growth and work-hardness at low temperatures—never requires annealing. Lasts five to fifteen times longer!

S. G. Taylor Chain Co., General Offices and Plant, Hammond, Indiana; Eastern Sales Office and Plant, Pittsburgh, Pennsylvania.

Send coupon for FREE Folder No. 85A

TAYLOR MADE

A GREAT NAME IN Chain SINCE 1873

S. G. Taylor Chain Co.
Dept. H, Hammond, Indiana
Rush free copy of Folder No. 85A giving all the facts on Taylor Made Alloy Steel Downtown Magnet Chain.

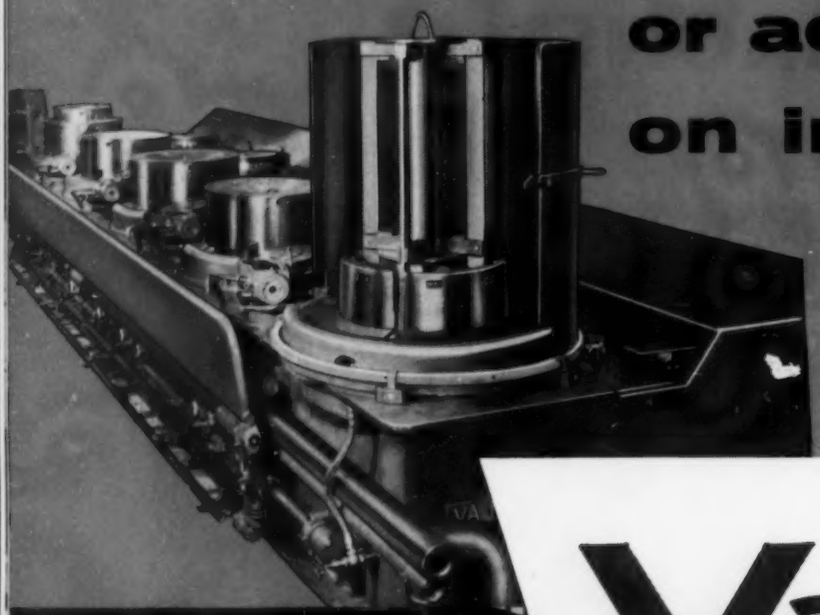
Name_____

Address_____

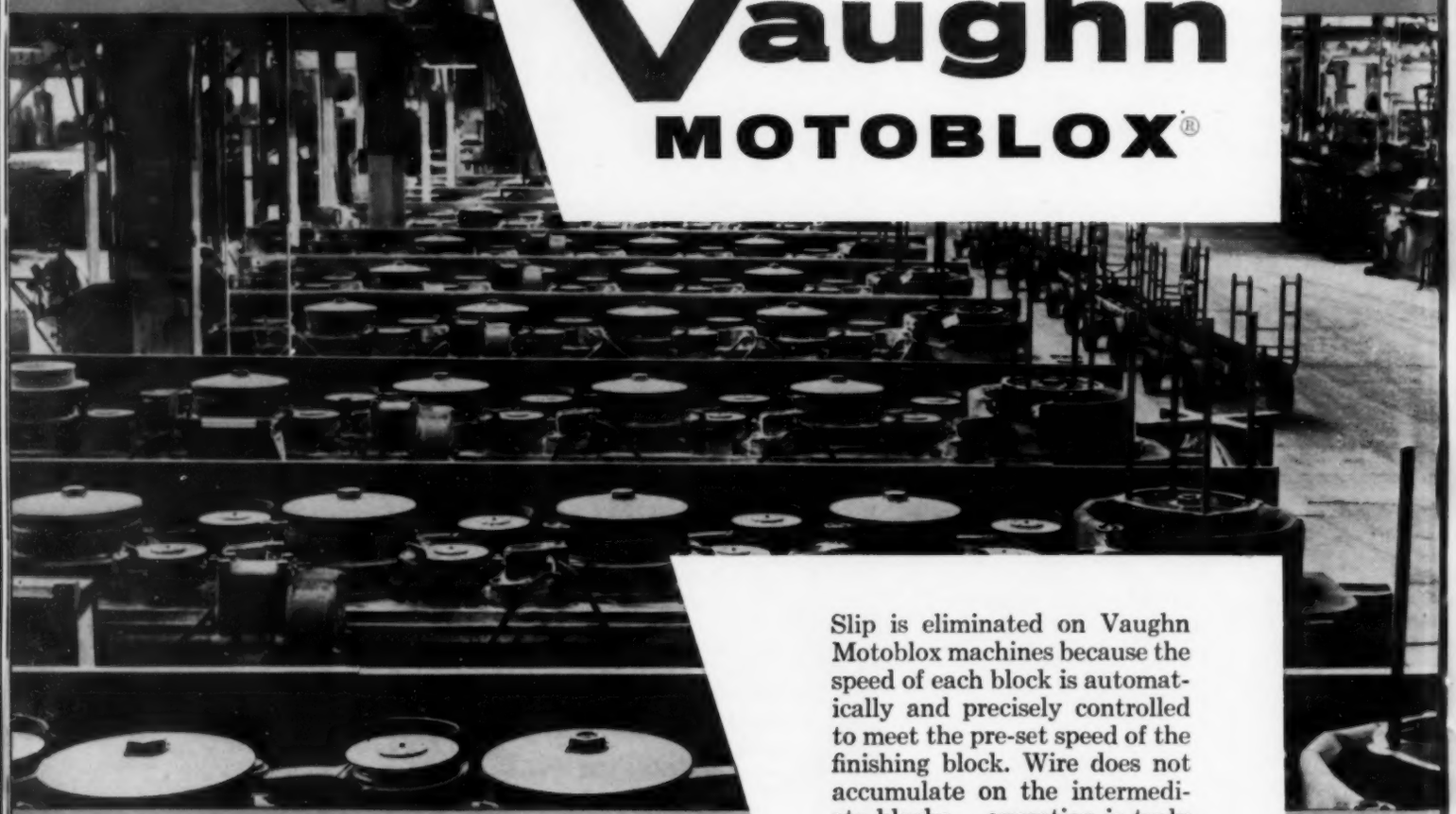
City_____ State_____

NO SLIP

or accumulation on intermediate blocks with



Vaughn®
MOTOBLOX®



Slip is eliminated on Vaughn Motoblox machines because the speed of each block is automatically and precisely controlled to meet the pre-set speed of the finishing block. Wire does not accumulate on the intermediate blocks—operation is truly continuous. ● The Motoblox facts can profit you: let us present them!

THE VAUGHN MACHINERY CO.
Cuyahoga Falls, Ohio, U.S.A.

COMPLETE COLD DRAWING EQUIPMENT . . . Continuous or Single Hole . . . for the Largest Bars and Tubes . . . for the Smallest Wire . . . Ferrous, Non-Ferrous Materials or their Alloys.

®

"Quick on the Draw!"

BLAW-KNOX PLANS EXPANSION PROGRAM

▲ An expansion and modernization program designed to integrate more fully the manufacturing operations in several of its product lines, has been announced by Blaw-Knox Co.

The program will be financed from earnings and from proceds of $15 million of 3½ per cent promissory notes, according to George L. Langreth, finance vice president of Blaw-Knox Co.

An initial 1955 program announced by W. Cordes Snyder, Jr., president of Blaw-Knox covers a five point program calculated to place the company in an even better position to serve its major markets—steel, processing, construction and energy.

FELLOWSHIPS OFFERED BY CARNEGIE TECH

▲ Carnegie Institute of Technology has announced opportunities for advanced study and research leading to degrees of Master of Science and Doctor of Philosophy in the fields of chemical engineering, chemistry, civil engineering, electrical engineering, mathematics, mechanical engineering, metallurgical engineering and physics. Teaching assistantships, graduate fellowships and research assistantships are available in most departments of the College for able graduate students. Normally, the duties assigned entail nine to 12 hours of laboratory instruction per week or their equivalent. Assistants are permitted to carry from two-thirds to seven-eights of a full load of graduate work. The stipend is $1680 per academic year for the first year and $1780 for the second, from which the student must pay his tuition.

Graduate fellowships, supported by outside agencies and special Institute funds, carry liberal grants based upon need, in addition to tuition. Such fellowships are offered by most departments in the College. They are awarded to outstanding graduate students to permit them to devote full time to advanced study and research. Fellowships are not awarded to beginning graduate students. These are also available in the Metals Research Laboratory, the Nuclear

Look overhead..see "NORTHERN"

NORTHERN CRANES *for severe service! for continuous operation! for safety and economy!*

The 40-ton NORTHERN SUPER CRANE shown is one of several Northern cranes operating in the Huntington Works of the International Nickel Company.

From drawing board to assembly floor no effort is spared in building uninterrupted service into NORTHERN HEAVY DUTY SUPER CRANES. They are built to stand rough handling, overloading and continuous operation. Mechanically, structurally and electrically they offer the maximum in safety and operating efficiency.

Northern Cranes are backed by over 55 years experience in designing and building cranes for steel mills, metal fabricating plants, automobile plants, paper mills, electrical manufacturers, railroads, and many other industries.

Let us send you Bulletin SE-108

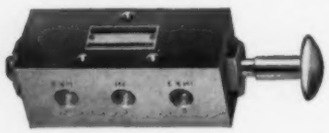
NORTHERN CRANES—HOISTS—TRAVELATORS

NORTHERN ENGINEERING WORKS
210 CHENE ST., DETROIT 7, MICH.

NEW, INEXPENSIVE, HIGHLY EFFICIENT

"O Quick-As-Wink® Type" VALVES

NOW AVAILABLE

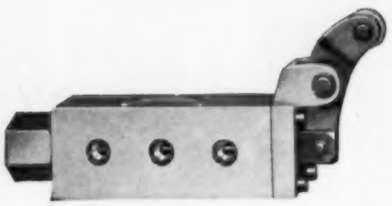


BUTTON OPERATED
(Push-Pull or Push Spring Return)

DIAPHRAGM OPERATED

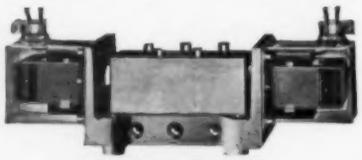
FOR A WIDE

PILOT CYLINDER OPERATED
(Single or Double Pilot)

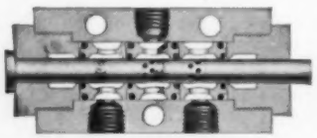


CAM OPERATED

VARIETY OF SERVICES



SOLENOID OPERATED
(Single or Double Solenoid)



CUT-AWAY VIEW OF INTERIOR
U. S. Pat. No. 2,645,450

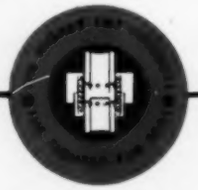
● These newly developed valves combine greatly simplified construction, positive positioning of all parts and quick, easy repacking in the field. There is no direct impingement of flow across the packings, greatly prolonging their life. All metal parts are aluminum except the hollow, radially ported, stainless steel plunger. ⅛" and ¼" pipe connections. 2, 3, 4 and 5-way actions. Write for Bulletin No. 531 today! *It gives full details.*

Ask us also about . . .

SINGLE PLUNGER SOLENOID VALVES in single or double solenoid designs. Low amperage requirement eliminates intermediate relays and simplifies electrical control circuits.

WATER SYSTEM VALVES pilot cylinder operated, sizes to 8". Can be installed with automatic remote control as a plant protection measure to shut off water to certain parts of the plant in case of emergency so the entire available supply is directed where it is most needed.

Quick-As-Wink
AIR AND HYDRAULIC
Control Valves



Hand, Foot, Cam, Pilot, Diaphragm and Solenoid Operated

Mfd. by C. B. HUNT & SON, INC., 1924 East Pershing St., Salem, Ohio

Research Center, the Petrolemum Research Laboratory and the Coal Research Laboratory.

Several departments and research laboratories employ research personnel for part-time research under the supervision of a member of the staff. Part-time research assistantships carry stipends comparable to teaching assistantships. Applications will be considered by the Institute from qualified students who wish to begin or return to graduate study in the fall of 1955. It is suggested that candidates write for application forms and information at an early date to Dean of Graduate Studies, Carnegie Institute of Technology, Pittsburgh 13, Pa.

COMPLETELY REORGANIZE LAMP DIVISION AT G-E

▲ The Lamp Division of General Electric Co. has been completely reorganized, it was announced by Donald L. Millham, G-E vice president and general manager of the division.

Creation of six product or business departments, each headed by a general manager, and a complete business organization of itself, and an Advanced Lamp Development Laboratory are involved in the reorganization. Two service departments, now in existence, complete the organization.

Reorganization of the division was made desirable because of the past rapid growth of the lamp business and its anticipated future expansion, according to Mr. Millham. He said the company's lamp business had tripled over the past 25 years, and that in 1955 the large lamp department alone would do nearly as much business as the entire lamp division did as recently as 1948.

Future Meetings

▲ The Air Pollution Control Association will hold its forty-eighth annual meeting at Detroit, Mich., May 22 to 26, 1955.

▲ The fifth annual "Instrumentation in the Iron and Steel Industry" Conference, sponsored by the Instrument Society of America, Pittsburgh section, will be held in Pittsburgh, Pa. Hotel William Penn, March 8, 9, and 10, 1955.

PRODUCTION CONTINUITY at Detroit Steel's new Portsmouth, Ohio, plant is aided by a G-E engineered power system. Primarily designed for reliability of service and for future expanded capacity, it provides power, for example to these G-E tandem cold strip mill main drives which total 11,500-hp. New facilities provide five times the former finished-product output.

G-E engineering services help Detroit Steel to double ingot capacity at Portsmouth, Ohio

Detroit Steel's sixty million dollar expansion at Portsmouth, Ohio is now complete. The project, an up-to-the-minute example of modern electrification, includes: blast furnaces; open hearth furnaces; soaking pits; blooming and slabbing mill; hot strip mill; pickle line; tandem cold strip mill; and temper mill and processing lines: co-ordinated electrical systems are a vital part of these facilities.

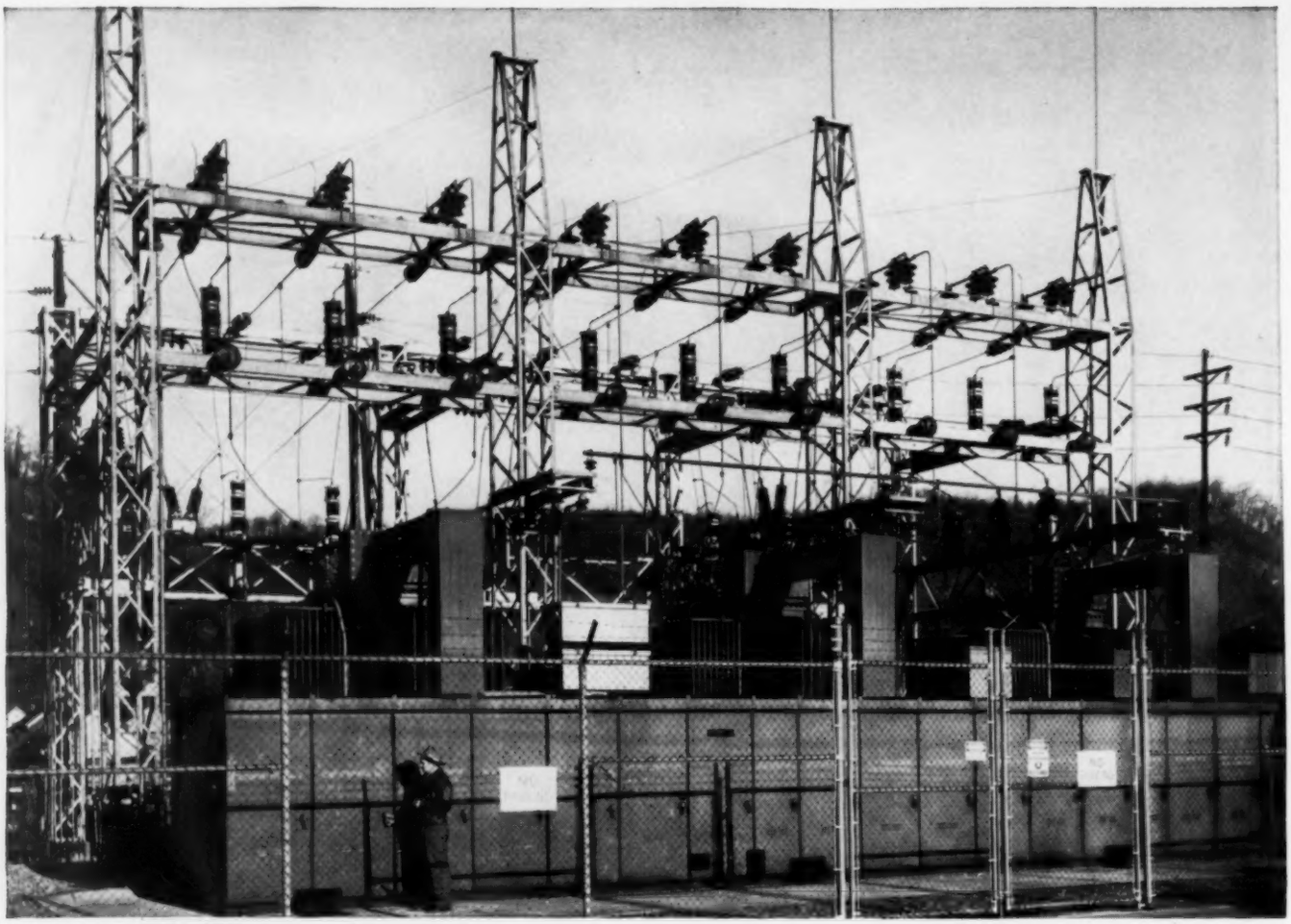
They were engineered and equipped almost 100% by General Electric working closely with such companies as Wellman Engineering Co., John Mohr and Sons, Loftus Engineering Corporation, United Engineering and Foundry Company, Pittsburgh Engineering and Machine Company, Morgan Engineering Company, Stamco, Wean Engineering Company, and Patterson-Emerson-Comstock, Inc.

In the planning stages, G-E application engineers helped define power system requirements. As work progressed, G-E project co-ordinators carefully timed electric equipment deliveries to conform to construction schedules. Finally, G-E field engineers helped supervise the equipment's installation to speed start-up.

The new facilities enable Detroit Steel to double ingot capacity, provide five times the former finished-product output. Practically automatic, the mill employs many outstanding examples of modern power distribution techniques that provide reliability for continuous output.

See Power Distribution Story

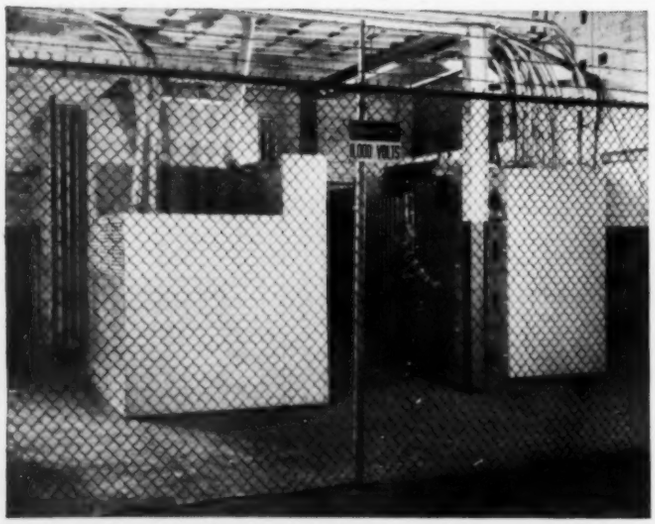
GENERAL ELECTRIC



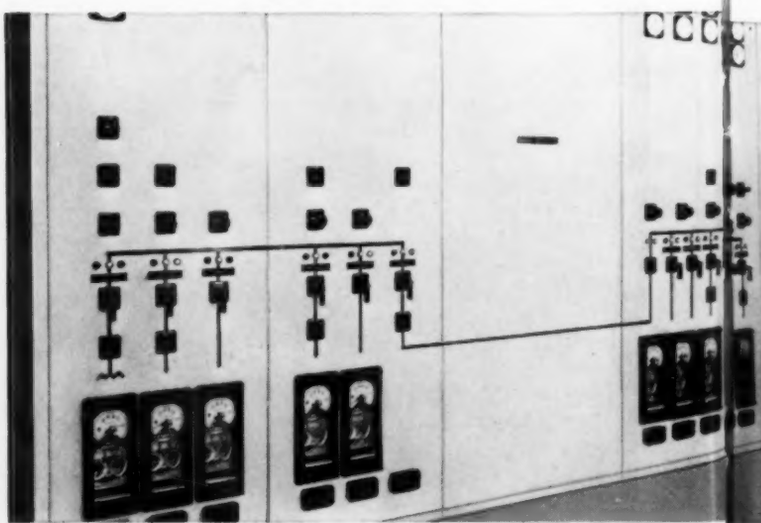
G-E PACKAGED SUBSTATION combines all electric equipment required between incoming high voltage lines and load feeder circuits. Here, all purchased power is brought into system at 34.5 kv and distributed at 11 kv to each major mill or furnace.

Engineered by General Electric for Detroit Steel . . . .

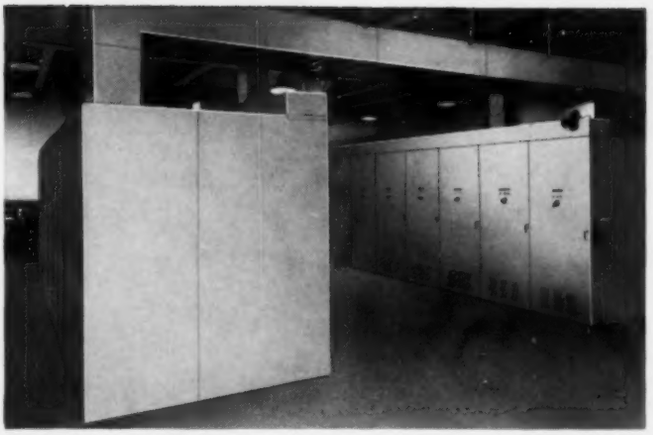
New power distribution system designed for



FLEXIBLE G-E INTERLOCKED ARMOR CABLE was used to advantage at these G-E unit substations at the Portsmouth plant. They needed no conduit, cut installation time and costs.



CENTRALIZED CONTROL of power system is provided in this G-E duplex panel. Indicators automatically notify load dispatcher of any trouble.



FACTORY ASSEMBLED, G-E metal-clad switchgear helps protect equipment and personnel, provides space-saving compactness. Circuit breakers are easily removed for maintenance.

UNIFORM VOLTAGE of power distribution system is maintained with aid of this G-E power factor and reactive kva regulator associated with tandem cold strip mill.

PRACTICALLY 100% G-E DRIVES were specified also for operating machinery throughout the plant, including, for example, the 350-cubic foot skip on this blast furnace.

reliability, easy operation, future expansion

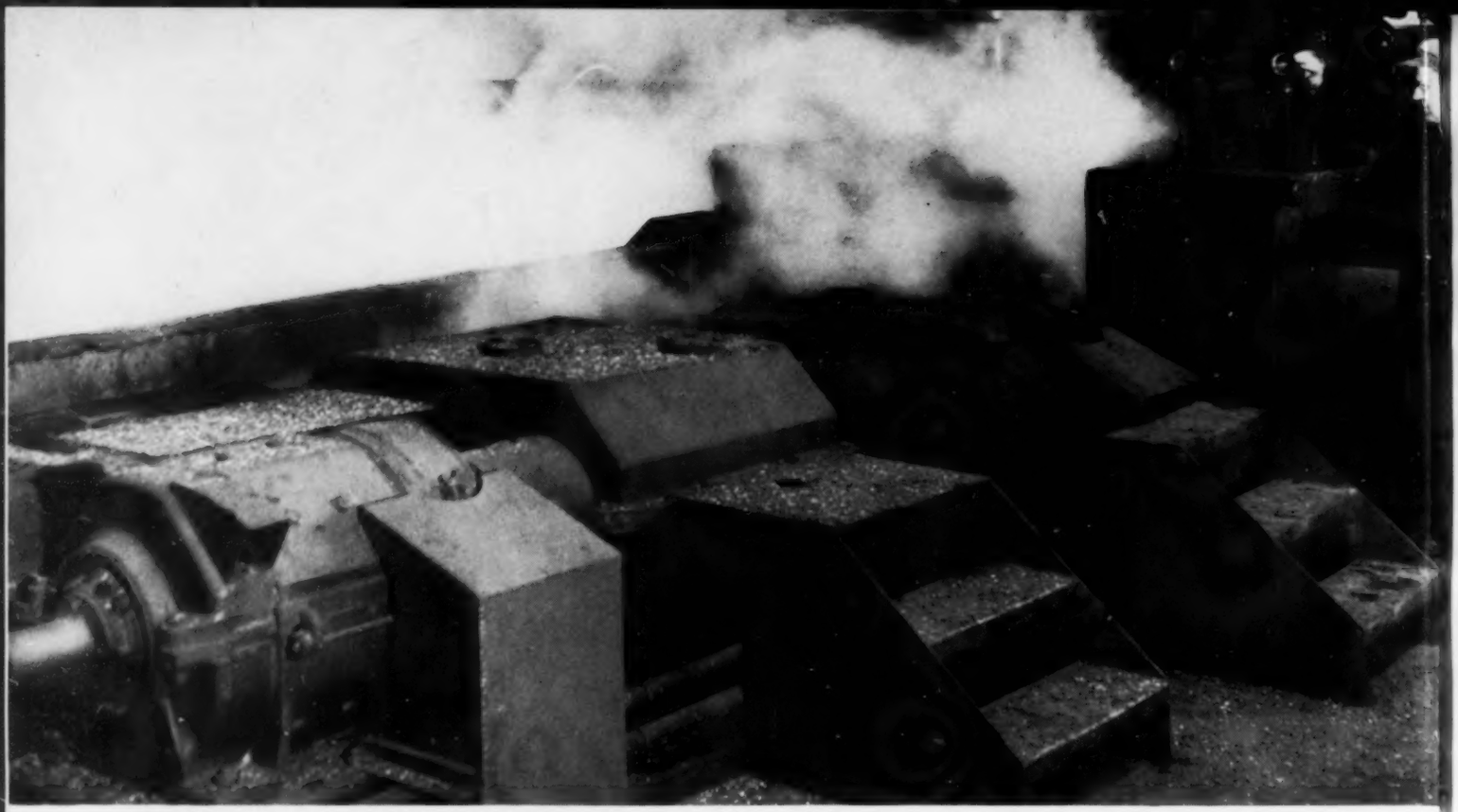
At Detroit Steel's new plant, complete loss of power would cost thousands of dollars an hour in lost wages and production alone. Therefore, General Electric helped design a reliable power system to match capacity, utilizing modern system techniques and equipment.

Close co-operation by all resulted in a more reliable, yet easily operated system, adequate for its job today and ready for future growth.

G-E engineering services are available to *you,* too—in modernizing your electrical systems to achieve higher mill speeds, increased tonnage output, lower operating costs. Contact your G-E Apparatus Sales representative early in your project planning stage. General Electric Company, Schenectady 5, N. Y. 659-103

Engineered Electrical Systems for Steel Mills

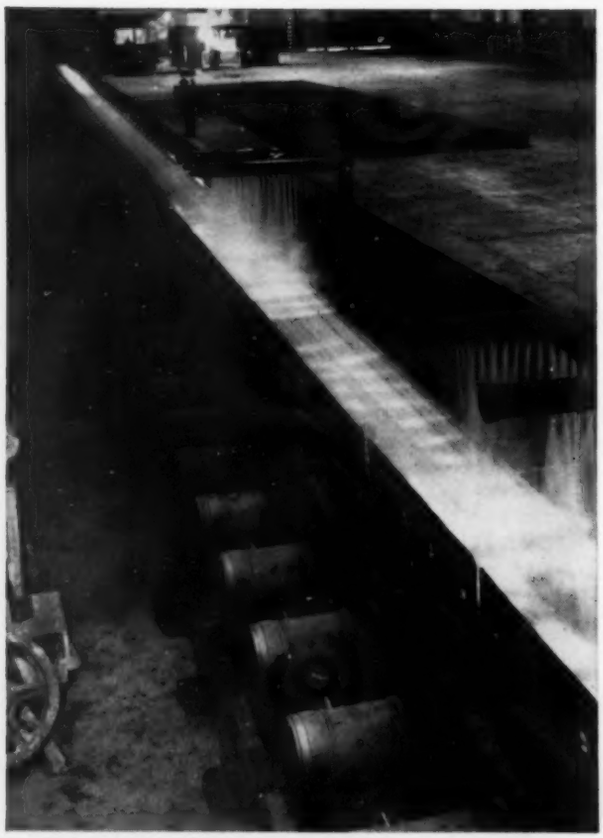
GENERAL ELECTRIC



VERSATILE MD-600 ARMORED MOTORS are shown here driving the roughing mill table. Ruggedly constructed, they are designed to withstand severe shocks, temperatures and reversing conditions. **Write for bulletin GEA-4654C.**

Specified for Detroit Steel . . .

G-E Armored motors take toughest steel-mill jobs — and last longer



MDY RUNOUT TABLE DC MOTORS, better protected against spray, dirt and grease, are easily maintained—last longer. **Write for bulletin GEA-5964.**

General Electric MD-600 armored motors and MDY runout table motors are natural choices in the electrical system for Detroit Steel's Portsmouth, Ohio plant expansion. Their better protection features and greater electrical capacities provide the reliability needed for continuous output. They've built a reputation as tough, dependable steel-mill performers.

MD-600 MOTORS—WELL PROTECTED by heavy cast-steel frames—operate under severe conditions. Whether a foot away from flying red-hot steel or drenched by water spray, they give dependable, low maintenance service.

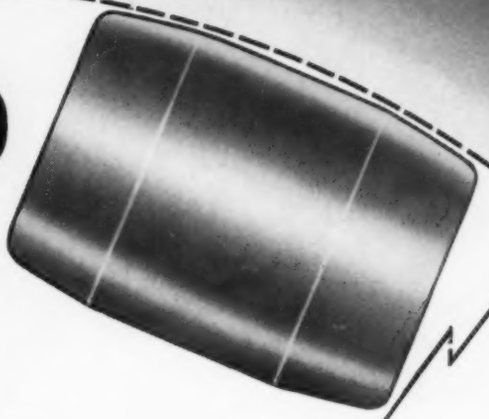
MDY RUNOUT TABLE MOTORS give top performance under the severest duty cycle. They stop, start and reverse quickly, withstanding mechanical shock and water spray. Their rugged electrical systems and low maintenance features are well-known in the steel industry.

IN ANY INDUSTRY, where the job is tough, these two motors are hard to beat. For more information, contact your nearest G-E Apparatus Sales Office. General Electric Company, Schenectady 5, N. Y. 810-2

Progress Is Our Most Important Product

GENERAL ELECTRIC

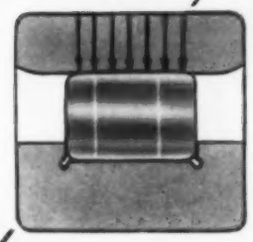
NOW... all Tru-Rol Bearings have CROWNED ROLLERS



● When a straight cylindrical roller bearing is under load, the highest stresses tend to concentrate at the roller ends. Stresses may become excessive and cause early bearing failure.

Crowning is a Rollway grinding refinement that adds a long radius curve to the roller ends. This relieves the high stress areas — allows the rollers to take heavier loads and reduces the effect of slight shaft misalignment or deflection. Bearings can be load rated at substantially higher values — provide a longer service life.

Crowning is but one of the many engineering advances built into Rollway Tru-Rol Bearings. Write for the complete story. Rollway Bearing Co., Inc., Syracuse, N.Y.



Crowned roller under full load — stress uniformly distributed.

Crowned Tru-Rol Bearings available in the following type:

Full Roller

Segmented Steel Retainer

Carefully selected crown radius, varying from 20" to 260", provides proper relief for normal loading to which bearing will be subjected.

+

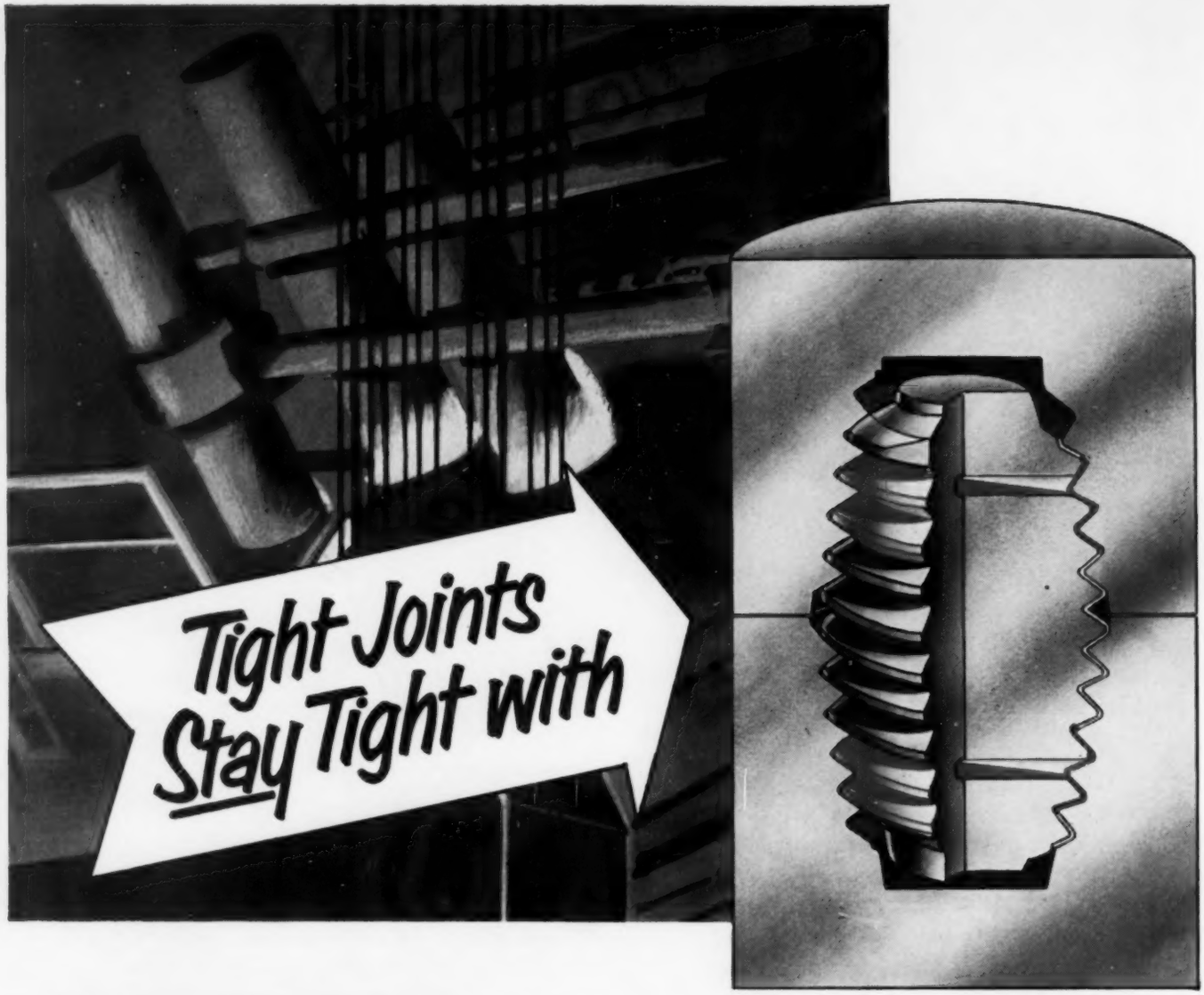
Stamped Steel Retainer with Guide Lips

New Rollway Tru-Rol Catalog features RBEC formula converted to simple nomogram. Send for your copy today.

ROLLWAY BEARINGS

COMPLETE LINE OF RADIAL AND THRUST CYLINDRICAL ROLLER BEARINGS

SALES OFFICES: Syracuse • Chicago • Toronto • Cleveland • Seattle • Philadelphia • San Francisco • Boston • Detroit • Pittsburgh • Milwaukee • Houston • Los Angeles



NATIONAL PITCH-RESERVOIR NIPPLES*

TRADE-MARK

THE NEW PITCH-RESERVOIR NIPPLE, an exclusive "National" product, is another major contribution by National Carbon Company to more efficient electric furnace operation. You can now be sure that tight joints will stay tight under normal load and service conditions.

"NATIONAL" PITCH-RESERVOIR NIPPLES, designated Type PR-F, are now available for electrode diameters from 14" to 24". Thoroughly proved in service, they are identical in strength, size, shape, tolerances, composition and quality to our standard, tapered, graphite nipples. Talk it over soon with your National Carbon Company electrode representative.

***PATENTS PENDING**
EXCLUSIVE DESIGN

HERE'S HOW IT WORKS:

Reservoirs near each end of the nipple contain pitch. As the electrode column becomes hot in service, the pitch flows from the reservoirs into the threaded sections of the joint and cokes out, cementing and locking the threads of the nipple and sockets together.

FOR ELECTRODES AND ELECTRODE SERVICE...
Rely on NATIONAL CARBON COMPANY!

The term "National" is a registered trade-mark of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.

Sales Offices: Atlanta, Chicago, Dallas, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco. *In Canada:* Union Carbide Canada Limited, Toronto

Personnel News...

Edwin O. Burgham has been elected president of the Weirton Steel Co. Mr. Burgham succeeds **Thomas E. Millsop** who was elected president of National Steel Corp. in April 1954, and is now vice chairman of Weirton. Other promotions announced were: **Charles E. Carr,** vice president — operations; **Edward B. Bennett,** general superintendent and **Glenn W. Gould,** assistant general superintendent. Mr. Burgham began his service with Weirton in the metallurgical department in 1923. He became assistant manager of the Weirton tin mill in 1925 and manager in 1930. After serving for 14 years in this position, Mr. Burgham became assistant general superintendent in 1944. He was appointed general superintendent in 1948 and advanced to vice president in charge of operations in February 1953. Mr. Carr came to Weirton in 1921 as a second helper in the open hearth department. He was promoted to assistant superintendent of that department in 1927 and superintendent in 1940. In 1943, Mr. Carr was appointed assistant manager of the Steel Works, advanced to manager in 1951, and to the position of assistant general superintendent in 1954. Mr. Bennett began his service with Weirton Steel Co. as a metallurgist in 1934. In 1943 he became assistant manager and in 1951 manager of the 10-in. and 16-in. strip mill. He was appointed assistant general superintendent in 1954. Mr. Gould started as a time clerk in the Weirton tin mill in 1929. He became assistant manager of the mill in 1944 and manager in 1953.

A. G. Ericson, chief engineer of Homestead and Duquesne Works, has been appointed assistant chief engineer — design of U. S. Steel Corp. Also announced were the appointments of **Harry S. Spitz** as chief engineer of Homestead District Works and **Charles H. Good, Jr.** as chief engineer of Duquesne Works, following the establishment of separate engineering departments in these plants. A native of Finland, Mr. Ericson joined U. S. Steel as a draftsman at Homestead in 1924. He advanced through successive appointments to the post of chief engineer in 1938. In 1950 he became chief engineer for Homestead and Duquesne Works, his position at the time of his present appointment. Mr. Spitz joined U. S. Steel in 1949 as assistant chief engineer at Clairton, and the following year was appointed assistant chief engineer at U. S. Steel's South Works, Chicago. In 1951 he returned to Pittsburgh as assistant chief engineer of the corporation's construction engineering bureau, and in 1953, he was appointed chief engineer at Fairless Works, his position at the time of his present appointment. Mr. Good was assistant to general superintendent Duquesne Works at the time of his present appointment.

A. J. Jermann has been appointed assistant superintendent of Republic Steel Corp.'s Numbers 5 and 6 blast furnaces at Cleveland, Ohio. Mr. Jermann had been general foreman of the furnaces since 1950. He joined Republic in 1933 and ten years later was named blower foreman.

Wilfred R. Riggs, Jr., was appointed assistant director of general planning, Kaiser Steel Corp., and **Robert H. Howard** was named supervisor, general planning.

F. M. Hamilton, who had been supervisor of agglomeration research at Jones & Laughlin Steel Corp.'s ore research division laboratory, Negaunee, Mich., has been appointed to a similar capacity at J & L's N. Y. ore division, Star Lake, N. Y.

Roy A. Eldridge has been appointed general traffic manager of Republic Steel Corp. He succeeds **Harry D. Rhodehouse** who for the past 27 years has been Republic's general traffic manager. Mr. Rhodehouse has been named a special assistant to handle problems dealing with traffic and related matters under the direction of the executive staff of the corporation. Mr. Eldridge has been traffic manager of Republic since 1938. He is also a vice president of the Liberia Mining Co. and will continue in this position.

William H. Ashton has been appointed works superintendent at the Cleveland, Ohio, Central Furnaces & Docks plant of American Steel & Wire Division, U. S.

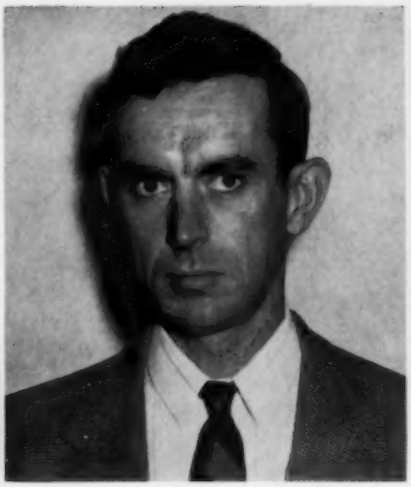
EDWIN O. BURGHAM

A. G. ERICSON

HARRY S. SPITZ

CHARLES H. GOOD, JR.

WILLIAM H. ASHTON



C. ALLEN DAVIS

SIDLEY O. EVANS

DAVID A. EDGECO

Steel Corp. He was formerly assistant division superintendent, Carrie Blast Furnace Division at Homestead Works. Succeeding Mr. Ashton at Homestead is **C. Allen Davis,** who has served since 1953 as general turn foreman of the blast furnace division.

Sidley O. Evans has been appointed to the newly created position of manager of tubing operations of the Babcock & Wilcox Co.'s Tubular Products division plant in Beaver Falls, Pa. At the same time, it was announced that **David A. Edgecomb** has been named to succeed Mr. Evans as superintendent of the extrusion department. Mr. Evans joined Babcock & Wilcox in 1944 as an electrical engineer after serving as a consultant with the company for two years previously. In 1949 he was made chief of engineering development in which post he supervised the development of new equipment and processes in the plant. When B&W became a licensee for the new French patented hot extrusion process for steel in 1950, he led a group in developing mechanization and methods to utilize the new process. Mr. Evans was made superintendent of extrusion when the new extrusion plant was put into operation that year. Mr. Edgecomb joined B&W in 1947 as a student engineer. He worked as a member of the engineering development department and later assisted in the development of equipment for use in the hot extrusion process. When the extrusion plant was built, he was made assistant superintendent, the position he held prior to his promotion.

J. Douglas Darby has been appointed assistant executive vice president — commercial of U. S. Steel Corp. Mr. Darby was first employed in the open hearth department of the Alan Wood Steel Co. He rose through various positions in his 20 years there to become general superintendent. He joined the sales department of U. S. Steel in 1939, and was made vice president of sales in 1948.

Julius E. Graf has joined Treadwell Engineering Co., as vice president in charge of engineering. Mr. Graf was formerly chief engineer of the Jones and Laughlin Steel Corp.

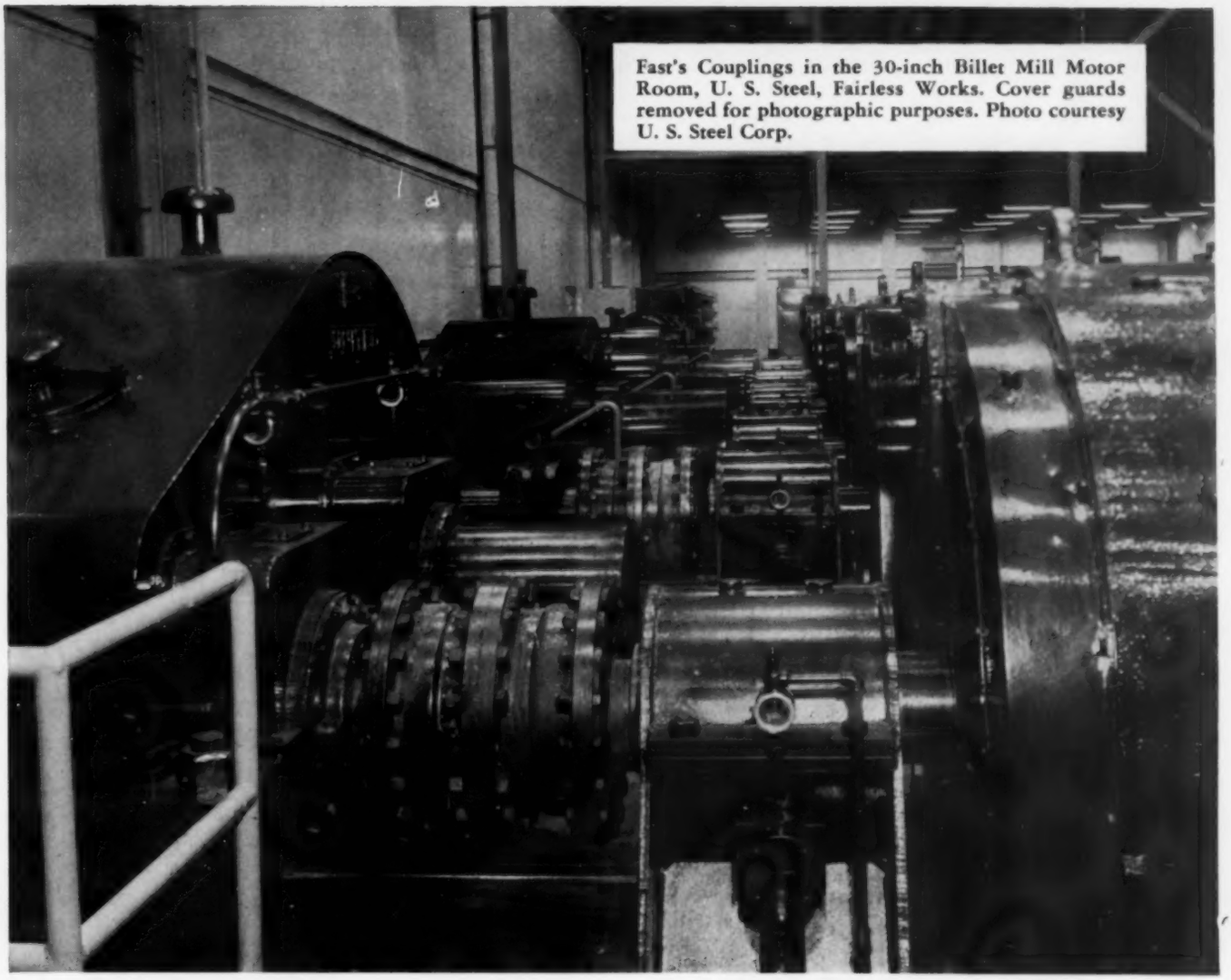
Louis M. Marshall has been appointed superintendent of the mason and labor department of Republic's Warren District steel plant. Formerly general foreman of the department, he succeeds the late **J. G. Hanes. Harry L. Anderson** has been named assistant superintendent of the department.

James P. Wiley has been named division superintendent, maintenance, National Works, National Tube Division, U. S. Steel Corp. Mr. Wiley has been with the division since 1916, starting as a machinist with National Works, McKeesport. He became general foreman, machine shop in 1935. From 1939 to 1940 he was assist-

JAMES P. WILEY

ant superintendent, maintenance. In 1941 he was transferred to Christy Park Works as superintendent, maintenance, later serving as assistant general superintendent from 1945 to 1948. He returned to National Works, and was appointed superintendent, lower division, maintenance in 1951. The same year he was transferred to shops and services division, maintenance department, as superintendent, his position prior to his new appointment.

Stephen P. Curtis has been appointed chief engineer of U. S. Steel Corp.'s Fairless Works. Mr. Curtis



Fast's Couplings in the 30-inch Billet Mill Motor Room, U. S. Steel, Fairless Works. Cover guards removed for photographic purposes. Photo courtesy U. S. Steel Corp.

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joined U. S. Steel in Gary in 1936. In 1949, he became the plant's assistant general supervisor of construction and the next year was appointed chief construction engineer of U. S. Steel's construction engineering bureau in Pittsburgh. He was transferred to Morrisville at the time of the Fairless Works ground-breaking.

Albert C. Redding has been appointed technical and development engineer to the central operating staff of Crucible Steel Co. of America. Before joining Crucible, Mr. Redding was production manager of the Kidd Drawn Steel Co. of Aliquippa, Pa. Mr. Redding started his business career in 1931 at the Homestead Works of U. S. Steel as a metallurgical observer. At Homestead he held the posts of senior industrial engineer, production supervisor, chief estimator, and general production supervisor. In 1948, he joined Firth Sterling, Inc., at McKeesport, Pa., as assistant superintendent of production planning, and in 1950 he joined Methods Engineering Council. In 1950, he joined Kidd Drawn Steel Co.

J. H. Dowling is executive vice president of the newly formed Follansbee Metals Corp. Other officers are: **Arthur Patterson,** vice president and treasurer; **Mark C. Craven,** vice president in charge of Pittsburgh, Pa. operations; **Thomas E. O'Neal,** vice president in charge of Rochester, N. Y. operations; and **L. E. Larson,** vice president in charge of Wallingford, Conn. operations.

Charles T. Siebert, Jr. has been appointed director of trade relations, U. S. Steel Corp., succeeding **David E. Jenkins** who will continue with the corporation in a

CHARLES T. SIEBERT, JR.

consulting capacity. Mr. Siebert has been associated with U. S. Steel for the past 37 years. His early experience was in the blast furnace department, and he served there as assistant chief engineer.

R. F. Allen and **C. I. Young** have been named vice presidents of the Laclede-Christy Co., Division of H. K. Porter Co., Inc. Mr. Allen is in charge of business at Laclede-Christy while Mr. Young will head operations there. Mr. Allen joined Porter in early 1954 as assistant to the executive vice president, later became vice president of the Buffalo Steel Division, and in late 1954 went to St. Louis to supervise activities at Laclede-Christy. Mr. Young previously was executive vice president of Union Fire Brick Co., and before that was assistant to the vice president, Harbison-Walker Refractories Co.

Joseph W. Kennedy, Jr., has been named vice president in charge of the Ohio Seamless Tube Division, Copperweld Steel Co. Mr. Kennedy succeeds **Evan W.**

JOSEPH W. KENNEDY, JR.

McNeill, who is retiring. Associated with Copperweld's Steel Division at Warren, Ohio, since 1940, Mr. Kennedy was previously operating assistant to the executive vice president. Before joining Copperweld, Mr. Kennedy was superintendent of the blooming mills at the Duquesne Works of U. S. Steel Corp.

Roy P. Williamson has been appointed director of sales of the Morgan Engineering Co., Alliance, Ohio. Mr. Williamson has recently been general sales manager in charge of industrial and material handling machinery at the Buda Co. at Harvey, Ill. He has also worked for the Shaw-Box Div. of Manning, Maxwell and Moore, Inc., Muskegon, Mich.

Benton W. Norton, formerly general superintendent of the Shenango Furnace Co., and Shenango-Penn Mold Co., has been appointed vice president and manager of Ingot Mold Division, Shenango-Penn Mold Co., and manager of the blast furnace division of the Shenango Furnace Co. He has been in the steel business since 1925, starting with Republic Steel Corp. in Youngstown. He held the positions of blast furnace and coke oven superintendent, assistant district manager and general superintendent of blast furnaces and mines in the Southern district of Republic. In 1945 he went with the National Tube Co. as assistant to the general superintendent of McKeesport division and was later transferred to the Lorain division where he became division superintendent of docks, coke plant, blast furnaces, open hearth and rolling mills. Mr. Norton joined the Shenango Furnace Co. and Shenango-Penn Mold Co. in 1952.

Carl F. Norberg was elected president of The Electric Storage Battery Co. The action followed the resig-

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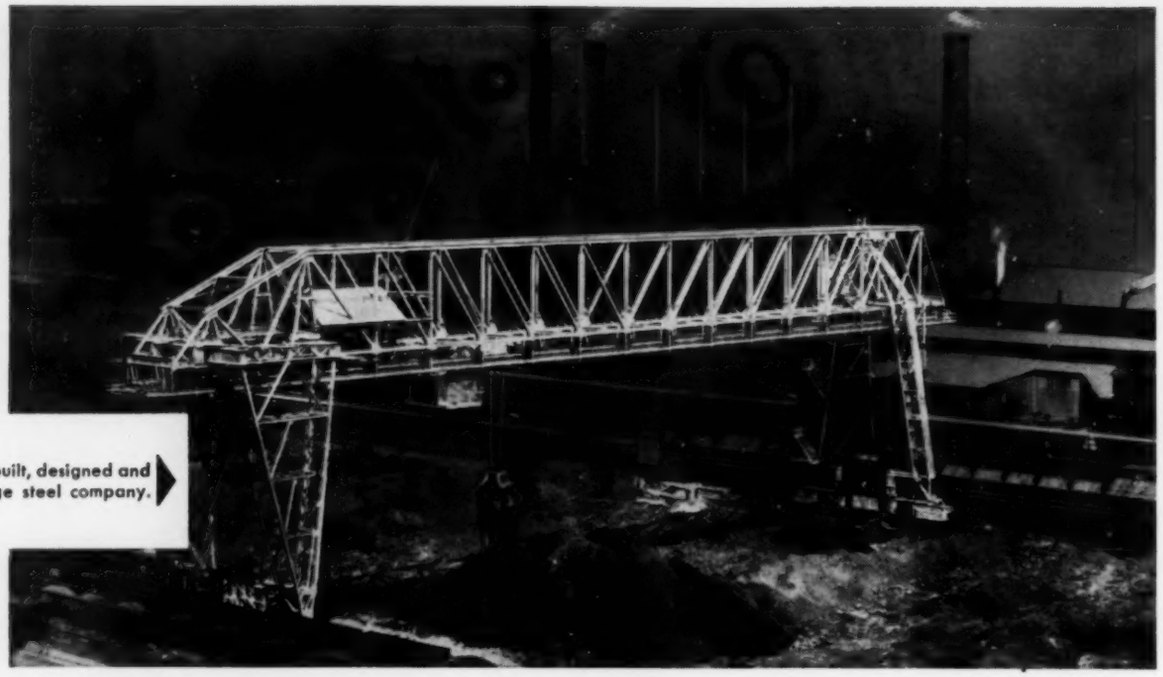

12-ton ore bridge, built, designed and installed for a large steel company.

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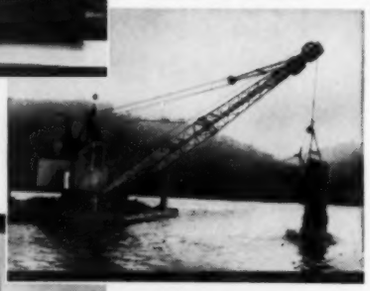
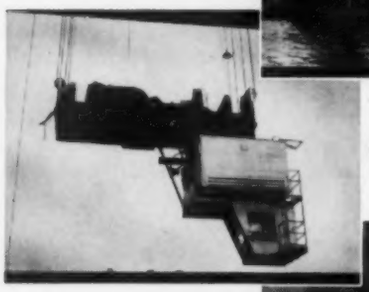
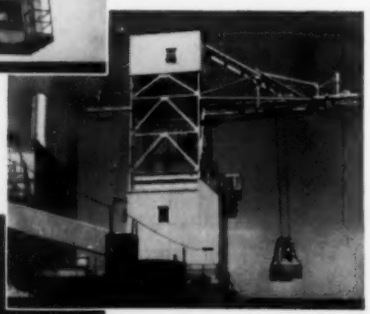
Travelling unloading towers built to handle imported iron ore at an Atlantic port.



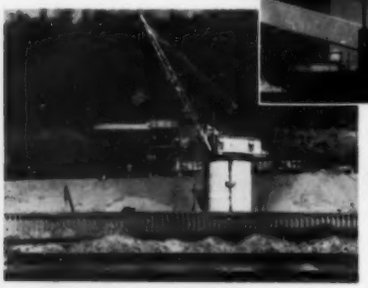
Whirler crane mounted on pontoon hull is used for dredging and general contract work.



Light-weight man trolley installation increased bridge handling capacity 60%.



Coal unloader designed and built for a large mid-western electric power company.



Stationary whirler crane designed and built to transfer coal from barges to hopper cars.

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R. L. ALLSHOUSE

CHRISTIAN F. BEUKEMA

W. G. NICHOL

HERBERT G. DILLON

nation of **S. Wyman Rolph** as president, chairman of the board and a director, after 38 years service.

R. L. Allshouse has been elected vice president in charge of foreign and flat product sales of the Aetna-Standard Engineering Co. He had been appointed manager of foreign sales in 1952, after serving as manager of sheet and strip sales since 1949.

Christian F. Beukema has been appointed president of Michigan Limestone Division of U. S. Steel Corp. Mr. Beukema, who has been vice president of Michigan Limestone, succeeds **Hugh S. Lewis,** who will continue with U. S. Steel in a consulting capacity.

W. G. Nichol has been appointed assistant to vice president — operations — steel of U. S. Steel Corp. In his new position Mr. Nichol will be responsible for packaging and loading. He was first employed by U. S. Steel at Youngstown District Works in 1925. He remained at Youngstown in various industrial engineering capacities until 1944 when he was transferred to Pittsburgh as assistant to the district industrial engineer. He was assistant chief industrial engineer — methods at the time of his present appointment.

Herbert G. Dillon was appointed sales manager of the Mead-Morrison Division, McKiernan-Terry Corp. He will have charge of the company's sales of coal and ore unloaders and bridges, grab buckets, car hauls and dumpers, and other material handling equipment. He was formerly associated with Heyl & Patterson, Inc., where he had been vice president in charge of sales since 1950, after having previously been sales manager for five years.

David F. Christnelly was named assistant sales manager of Stearns Magnetic, Inc.

Harry C. Platt has been elected executive vice president of the Engineered Castings Division of American Brake Shoe Co. He was formerly vice president in charge of production.

Chester M. MacChesney has retired as chairman of the executive committee of Acme Steel Co., after 38 years of service with the Chicago firm.

John Krause, Jr. has been named assistant to the general manager of sales, Pittsburgh Screw and Bolt Corp. Mr. Krause had been associated for 27 years with Oliver Iron and Steel Corp., having recently resigned from the position of assistant general manager of sales.

Chester R. Austin has joined the staff of Kaiser Engineers Division of Henry J. Kaiser Co. He will head the oxygen steel division for the engineering firm which

CHESTER R. AUSTIN

holds the U. S. rights for the European steelmaking process from Brassert Oxygen Technik A. G. Before joining Kaiser, Mr. Austin was associated with Koppers Co., Inc. where he was manager of the development section, research department. His experience included serving as technical representative on the use of oxygen in the blast furnace at Bethlehem Steel Co. in Johnstown, Pa., and work on the coal gasification plant built for the U. S. Bureau of Mines in Mo.

Orrin S. Braden, Jr., formerly assistant superintendent, Blast Furnaces North, Steubenville Works, Wheeling Steel Corp., has been appointed supervisor of

training. He has been with Wheeling Steel since 1951 when he was made supervisor of blast furnace practice at the Steubenville Works. Prior to joining Wheeling, he was affiliated with Crucible Steel, Armco Steel, and Youngstown Sheet and Tube Cos. **Edward P. Quick** succeeds Mr. Braden as assistant superintendent, Blast Furnaces North, at the Steubenville Works. He has been with Wheeling since June, 1949 when he enrolled in the company's practice engineering program in the Blast Furnace Department at the Steubenville Works. In 1950 he was made a foreman in that department.

O. M. Sievert, formerly assistant district manager of Elliott Co.'s Kansas City office, has been named district manager.

Richard O. Horning, assistant treasurer of Mesta Machine Co., was elected a member of the Board of

RICHARD O. HORNING

Directors, succeeding the late **Walter J. Hirth.** Mr. Horning began his career with Mesta in 1934, serving in various departments including roll sales engineering.

S. Whitney Dickey has been appointed assistant vice president of the Brake Shoe & Castings Division of American Brake Shoe Co. Mr. Dickey was formerly eastern district sales manager for the division in New York.

Willis J. Wenger has been appointed assistant vice president, roll department of Continental Foundry & Machine Co. He has served as sales engineer in the roll department since he joined Continental twelve years ago. Formerly, he had been associated with Birdsboro Steel Foundry and Machine Co.

H. B. Zeppenfeld was appointed sales manager, electrical connector division, Joy Manufacturing Co.

William C. Vokolek has been named vice president and works manager of the Franklin Steel Division of Borg-Warner Corp. Mr. Vokolek joined Borg-Warner's Calumet Steel Division in 1926. He served as production manager of Calumet and was transferred to Franklin Steel, as works manager, in 1947 when Borg-Warner acquired that property.

Clinton B. Fleming has been appointed chief industrial engineer at Laclede-Christy Division of H. K. Porter Co., Inc. Previously, Mr. Fleming was plant engineer for Buffalo Steel Division of the company.

Roy Dehn has been appointed director of engineering of the Cleveland Crane & Engineering Co. This is a new

ROY DEHN

position created to integrate the engineering activities of the company. Mr. Dehn was formerly chief engineer of the heavy machinery division. **Alfred W. Schultz**

ALFRED W. SCHULTZ

succeeds Mr. Dehn. He will be in charge of heavy overhead traveling crane, press and shear engineering.

Fred W. Arndt was named chief engineer, and **Peter L. Veit** was appointed direct sales engineer of Heil Process Equipment Corp.

R. J. Compton, director of personnel of E. W. Bliss Co., has been named to the office of vice president.

Edward W. Clark, works manager of the Calumet Steel Division of Borg-Warner Corp., has been elected a vice president of the division. Mr. Clark will also continue to serve as works manager. He has been associated with the division since 1933 and for several years was plant superintendent.

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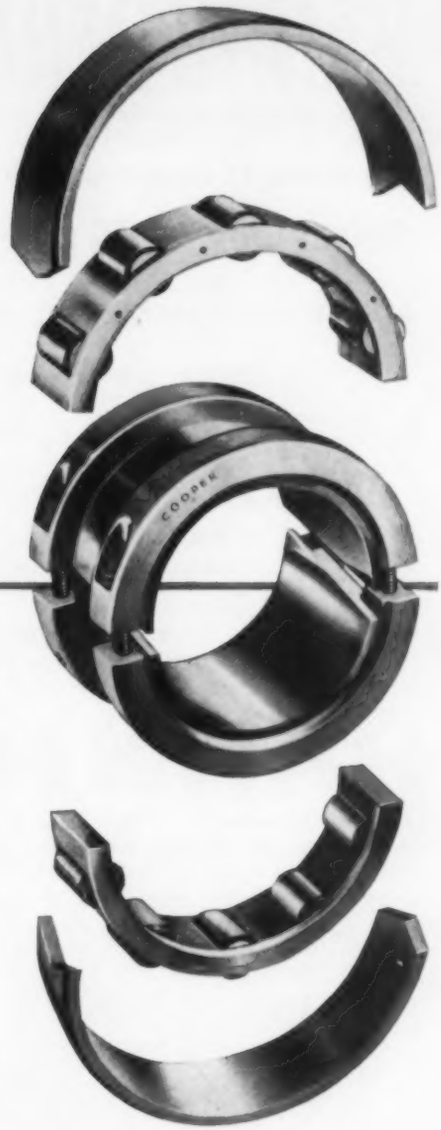

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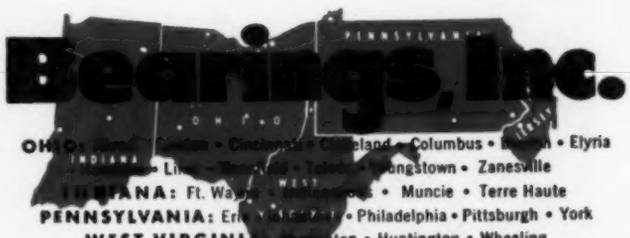

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S. D. Payzer has been named vice president in charge of engineering, a newly created position in the D. J. Murray Manufacturing Co.

Bernard Schneider was promoted to chief engineer of the conveyor equipment section of the Chain Belt Co.

Boyd M. Johnson, formerly assistant general manager, has been appointed general manager of the Refractories Division of the Carborundum Co. He succeeds **Clarence E. Hawke,** who has retired from active direction of the division.

Obituaries

Harry W. Trump, 63, southwest district manager of the industrial division of the Timken Roller Bearing Co., died Dec. 25. Mr. Trump had been associated with Timken since 1927.

L. A. Heath, who was the technical advisor of sales in the technical department of Morganite, Inc., died November 17. Mr. Heath was well known in the steel industry. He was also very active in carbon brush standardization work and served actively on the AISE Carbon Brush Committee.

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Corrugating and Complete Line of Culvert Equipment—Slitting and Coiling Equipment for Ferrous and Non-Ferrous Material in All Capacities—Warehouse and Steel Mill Cut to Length Lines for Shearing and Levelling Sheets from Coils—Shears for Shearing Sheets and Plates Both Underdriven and Overdriven Types in all Capacities up to 1¼" plate.

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JANUARY, 1955

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Note: Post cards expire three months after publication date.

(1) Materials Handling Equipment

A dozen models of tongs, a motorized hook, and a "C" Hook pallet lifter are illustrated in a four-page leaflet just issued by Heppenstall Co. A new motorized sheet lifter is shown, as well as automatic tongs with motorized, rotating shoes that will up-end or down-end skid boxes while lifting them. A series of four drawings depicts how Heppenstall tongs grasp a load and carry it safely, with no need for a ground crew to fasten or unfasten it.

(2) Waste Treating Equipment

Hardinge Co., Inc., has just published a completely new 20-page catalog on their line of equipment for water, sewage and industrial waste treatment. The catalog shows details of construction and specifications for circular clarifiers, up to 200 ft diameter, and rectangular clarifiers with crane type scraping mechanism. It also briefly describes digesters and automatic backwash sand filters. Equipment applications discussed in the booklet include municipal sewage treatment, municipal and industrial water treatment and industrial liquid waste treatment, connected with coal washeries, steel plants, pulp and paper plants, sand and gravel plants, and oil refineries. (Bulletin No. 35-D)

(3) Muffles and Retorts

On-the-job stories and pictures are featured in a six-page, two-color bulletin describing thermalloy high-heat-resistant muffles and retorts, available from the Electro-Alloys Division of American Brake Shoe Co. The bulletin describes how these high alloy castings are designed to resist abrasion, corrosive gases and excessive heat up to 2100 F. A breakdown of the thermalloy group of high alloys into Alloy Casting Institute (A.C.I.) grades and alloy content is included. Free design and engineering services are also offered. (Bulletin T-239)

(4) Flow Meters

Measurement of flow of liquids with suspended solids for water supply and waste treatment applications in industrial plants is discussed in a new, 12-page bulletin issued by Bailey Meter Co. Principle of operation; indicating, recording, and integrating combinations; telemetering possibilities; and engineering data on flumes and weirs are also given. (Bulletin M22-5)

(5) Storage Batteries

Battery selection techniques are emphasized in a revised edition of a manual recently announced by the Electric Storage Battery Co. The manual deals with storage batteries for stand-by power, emergency lighting and switchgear applications. A discussion of charging equipment and simplified battery maintenance techniques also is included. Storage battery installation procedures are described and illustrated by numerous photographs. The publication is designed for engineers and supervisory personnel in power stations, electric utility companies and engineering construction firms. It also is suitable for trained personnel in industrial plants, office buildings and other locations requiring emergency lighting or uninterrupted power for any purpose. (Bulletin 210)

(6) Crane Cab Conditioning

A new 20-page bulletin by the Lintern Corp. lists briefly and accurately the whys and wherefores of crane cab air conditioning. The brochure illustrates and describes crane cab air conditioning units for every need — the split system Aire-Rectifier and the self contained units. (Bulletin AC-549)

(7) Carbide Price List

A new catalog covering latest prices and specifications on standard tools and blanks in its 300 series steel cutting carbides — grade 350 and 370 is announced by Carboloy Department of General Electric Co. The 16-page publication includes all blanks and shapes introduced since development of the series a year ago. It also lists several new tools and blanks added to the line recently, in various styles and shapes, such as throw-away inserts, right and left hand offset threading and mechanically held blanks. (GT-305)

(8) Heater Case Studies

A brochure of engineering case studies, recently released by Dravo Corp., describes eight metalworking applications where warm air space heaters were used to temper large volumes of fresh make-up air for plant ventilation. Each bulletin in the brochure discusses an individual company's ventilation problem, and tells how oil or gas fired space heaters facilitated the venting of toxic and noxious fumes, odors and dust. These air contaminating substances originated in areas set aside for pickling, electrolytic deposition, hot-dip tinning, degreasing, hot salt baths, hot galvanizing, welding, painting, and in foundries.

(9) Thermocouple Unit

A data sheet published by Leeds and Northrup Co., describes a new immersion thermocouple which enables operators of open hearth and electric furnaces to measure bath temperatures on a full-time operating basis. It explains how ex-

pendable parts can be immediately returned to service after each immersion, with no cooling-off or preheating — numerous "standby" units for each furnace are unnecessary. (Process Data Sheet 643(1)

(10) Electrical Precipitation

A 28-page bulletin has been published by Research-Cottrell, Inc., on electrical precipitation equipment. The bulletin describes the general principles of electrical precipitation, and individual sections are devoted to applications in power plants, blast furnaces, ferromanganese furnaces, iron cupolas, and open hearth furnaces. Installation photographs and diagrams supplement the text.

(11) Hand Lift Truck

The Yale & Towne Manufacturing Co., pictures and describes the Yale zephyr hand lift truck in a newly revised four-page bulletin. This truck which is light in weight, was designed specifically for carrying loads up to 1000 lb. Among the zephyr hand truck features described in this bulletin is a single action, easily accessible treadle which controls the elevation of the load, a front wheel that rotates on roller bearings with double race ball bearing swivel to provide easy steering and structural angles which are welded to the rigid deck form to provide a wider and more substantial load carrying platform. A table which provides specifications for the various model numbers is included in this bulletin.

(12) Circuit-Breaker

Nelson Electric Manufacturing Co., has published a bulletin describing a five and 15 kv class circuit-breaker arrangement known as a replacement unit. (Bulletin 726-100)

(13) Plastic Tape

A new four-color folder published by Labelon Tape Co., Inc., describes a pressure sensitive plastic tape known as Labelon. Pictures and descriptive material show many of the hundreds of uses of this unusual new labeling aid, and an actual sample is attached to the folder. (Folder No. 5)

(14) Cinder Cars

M. H. Treadwell Co., Inc. has published a new catalog describing their cinder cars. The standard features of these cinder cars are discussed, and illustrated throughout the brochure are the numerous designs available. (Bulletin No. 61)

(15) Fire-Resistant Fluid

"Pydraul F-9," a fire-resistant industrial hydraulic fluid, is discussed in a 20-page booklet published by Monsanto Chemical Co. The booklet includes a step-by-step check list for converting a system, and lists a wide variety of equipment and industries in which the fluid has been used in the past several years. The brochure explains how this fire-resistant hydraulic fluid can be readily reclaimed, and fluid cost greatly reduced, by using a simple recovery and filter system. In addition, the booklet includes a comprehensive list of suppliers of packings, seals, paint, and other hydraulic components suitable for use with the fluid.

(16) Power Connectors

The latest information on power connectors for use with aluminum and copper conductors for every application is available in a catalog published by Delta Star Electric Division, H. K. Porter Co., Inc. An extensive data section to assist in estimating, planning and engineering is one of the ten sections included in the brochure. Other sections cover connectors for tubing to tubing; cable to cable; tubing to cable; tube or bar; square tubing; flexible connectors; grounding and stud connectors; and terminal lugs.

(17) Blast Cleaning Unit

Described in a bulletin published by Pangborn Corp. is their "RG Rotoblast" unit. Carefully developed line drawings and cut-away views illustrate the construction features of the unit pointing up its efficiency in abrasive flow as well as the simplicity of operation and maintenance which characterizes its basic design. (Bulletin 227)

(18) Metal Processing Equipment

Pictured and described in a new four-page, two-color brochure available from Stanat Manufacturing Co., is a complete line of laboratory and production rolling mills, rotary gang slitters, levelers and accessory equipment. (Bulletin No. 1310-1)

(19) Worm Gear Sets

A standard line of worm gear sets has been cataloged by Foote Brothers Gear and Machine Corp. The 24-page brochure includes ratings and specifications on the gear sets. (SW No. 1)

(20) Temperature Detector

Available from Leeds & Northrup Co., is a data sheet describing temperature detectors. The sheet covers use of these detectors for either direct sighting applications to measure the temperature of stationary or moving surfaces or for sighting into closed-end target tubes to measure the temperature of a furnace atmosphere or other medium. Specifications give characteristics; list metal and ceramic sighting tubes; and discuss both open and closed-end types of mountings. (NS-3(1)

(21) Water-Cooled Lens

A water-cooled lens system for industrial television is described in a new catalog published by Engineering Products Division of RCA. Included in the leaflet is a list of specifications and features of the system. (E.52)

(22) Panelboards

General Electric Co.'s, Distribution Assemblies Department has published a complete package of new descriptive bulletins on distribution and lighting panelboards. The new promotional package consists of nine two-color bulletins outlining the application and outstanding features of the panelboards. All bulletins include complete ratings, catalog numbers, dimensions, specifications and other engineering data important to the proper selection and application of this equipment.

(23) Rust-Prevention

The Rust-Oleum Corp., has just released a 24-page catalog on rust prevention. The new, enlarged catalog features 98 color chips of Rust-Oleum products and in-

cludes complete instructions for surface preparation and application of primers, short oil type, long oil type, machinery and implement finishes, chemical and heat resistant types, sealers, oil field finishes, thinning oils, and floor and masonry coatings. Among the new products described are the new restful color group of finishes developed to provide new color harmonies for plant interiors and machinery surfaces; oil field finishes, especially prepared to match original manufacturers' colors and resist extreme rust-producing conditions of the oil fields; and the exclusive, extra-long-nap lamb's wool roller that reaches around wire fences to coat approximately 70 per cent of the other side at the same time, making up to 40 per cent savings possible. Application photos are used throughout the book to show exactly how each type of product is used. In addition, two pages of the new catalog are devoted to questions and answers.

(24) Perforated Metals

A liberally illustrated new 114-page catalog has just been published by Standard Stamping & Perforating Co. Space is devoted to helpful buying information, the end uses of perforated metal and manufacturing processes. Any one interested in the design or manufacture of products containing perforated metal will find this catalog an invaluable reference.

(25) Equipment Installations

Available from Eichleay Corp. is a 32-page booklet which covers many of the company's installations. Recent projects are pictured and described throughout.

(26) Thickness Tester

Branson Instruments, Inc. has prepared a new six page catalog on thickness testers. A table summarizing characteristics and applications of five different models is shown. Also illustrated is the construction of various transducer types. This catalog brings together all current information previously published in several other articles and adds new information not previously available.

(27) Spacer Coupling

Available from Falk Corp., is a four-page folder describing a type F steelflex spacer coupling. Included in this folder are instructions for installation and maintenance of the coupling, and cut-away drawings showing lubrication during assembly.

(28) Overhead Cranes

A bulletin on the selection of overhead cranes is published by Whiting Corp. This booklet is packed with important data that is of interest to all concerned with heavy materials handling. Sample specifications, erection and initial operation, and structural framework recommendations, are a few of the items in this helpful booklet. (Bulletin Unit 79)

(29) Lift Truck Operation

A two-color cartoon technique booklet designed for easy reading and packed with information about the operation of a lift truck, preventive maintenance, safety and basic materials handling is available from Hyster Co. Prepared for use as part of an operator training program, this 24-page booklet is slanted for both the beginner and the experienced operator. It can be studied individually by the operator himself or used as a guide by instructors.

(30) Multi-V Drives

A new 100 page manual published by Worthington Corp., presents a scientific and simplified method for rating V-belts. Each popular 60 cycle motor speed with complete drive selections is shown on separate pages. A table on drive selections contains nearly every possible stock sheave combination and each belt column in the table section has its own series of arc and length correction factors. The use of a simple graph to find effective diameters eliminates the new De factor for sheave diameter and ratio and saves on multiplication steps. Service factors for proper duty classifications are based on load requirements and hours of service, thus eliminating the general practice of guessing the service factor applicable to the various classes. In addition to generally accepted theories on V-drive engineering, such important factors as small diameters sheaves, centrifugal force, average hours per day operation and other conditions affecting belt life, have been considered. (Book No. V-1400-E2F)

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IRON & STEEL ENGINEER
1011 EMPIRE BUILDING
PITTSBURGH 22, PA.

IRON & STEEL ENGINEER
Send The *free* Booklets Circled Below:

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PUBLICATIONS CURRENTLY OFFERED by Iron and Steel Engineer Advertisers

ITEM	COMPANY	BULLETIN	DESCRIPTION
50	ADALET MFG. CO.	BULLETIN E.	Vapor-tight fixtures.
51	AEROVENT FAN CO., INC.	FOLDER V-50.	Fans that provide high-velocity, straight line air delivery.
52	AMERICAN FLEXIBLE COUPLING CO.	CATALOG 501 AND BULLETIN 1052.	Fully crowned tooth form couplings.
53	BAILEY METER CO.	SPEC. E65-1 AND E12-5.	Analyzer-recorder on combustion economy
54	E. W. BLISS CO.	BULLETIN 40-A.	60-page rolling mill brochure.
55	BUSSMANN MANUFACTURING CO.	BULLETINS FIS, HCS.	Dual-element and Buss Hi-Cap fuses.
56	CLARK CONTROLLER CO.		Descriptive literature on Clark type CY starters.
57	CLARK EQUIPMENT CO.		Details on Y-260, new 26,000-lb truck.
58	DURABLA MFG. CO.		Bulletin on pump valve units.
59	DURALOY CO.	BULLETIN NO. 1-Du-7.	Details on high-alloy castings.
60	ELECTRIC CONTROLLER & MFG. CO.	BULLETIN 942-B.	Complete data on Tab-weld plate resistors.
61	ELECTRIC CONTROLLER & MFG. CO.	BULLETIN 900-L.	All-welded lifting magnets.
62	ELLIOTT CO.		Mill motor bulletin.
63	FALK CORP.		Details on all-steel shaft mounted drives.
64	FARREL-BIRMINGHAM CO., INC.	BULLETIN 273.	36-page bulletin on rolling mills.
65	FARVAL CORP.	BULLETIN 26.	Information on centralized lubrication.
66	FULLER CO.	BULLETIN C-5A.	Rotary compressors.
67	GENERAL ELECTRIC CO.	GEA-5664.	Metal-clad switchgear.
68	GLEASON REEL CORP.		Complete literature on reels.
69	HANNIFIN CORP.	BULLETINS 113, 213.	Hydraulic and fluid power cylinders.
70	HYATT BEARINGS DIVISION, GENERAL MOTORS CORP.		Roller bearings catalog.
71	KOPPERS CO., INC., FAST'S COUPLING DEPT.		Information on couplings.
72	LINK BELT CO.	BOOK 2416.	Belt conveyor idlers.
73	LUBRIPLATE DIVISION, FISKE BROTHERS REFINING CO.		Complete data on lubrication.
74	MACKINTOSH-HEMPHILL CO.		Corrugated cinder pots.
75	MINNEAPOLIS-HONEYWELL REGULATOR CO.	CATALOG 1531 AND DATA SHEET 4.3-4a.	Details on control with electronic instruments, and fuel air-ratio controllers.
76	MORTON MFG. CO.	BULLETIN 48-S.	Machine tools and automatic welding machines.
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78	NORTHERN ENGINEERING WORKS.	SE-108.	New super-cranes.
79	OHIO ELECTRIC MFG. CO.	BULLETIN 112.	Magnets and magnet controllers.
80	OHIO KNIFE CO.		Hardened bedway cross sections.
81	PACIFIC PUMPS, INC.	BULLETINS 106, 109, 118.	Boiler feed pumps.
82	PENNSYLVANIA TRANSFORMER CO.	BULLETIN 951.	Class H transformers.
83	PITTSBURGH LECTROMELT FURNACES.	BULLETIN 9.	Data on Lectromelt furnaces.
84	RADIO CORPORATION OF AMERICA.		Industrial TV in steel mill operations.
85	RAMTITE CO.		Castable and Gunning Refractories Bulletin.
86	RAMTITE CO.		Steel plant catalog.
87	ROLLWAY BEARING CO., INC.		Data on rollway bearings.
88	RUST-OLEUM CORP.		Rust preventive literature and color chart.
89	SELAS CORP.		Radiant heat.
90	SKF INDUSTRIES, INC.	BULLETIN 365.	Type "C" spherical roller bearings.
91	SPRAYING SYSTEMS CO.	DATA SHEET 6120.	Industrial spraynozzles.
92	S. G. TAYLOR CHAIN CO.	FOLDER 85A.	Alloy steel magnet chain.
93	UNITED STATES GRAPHITE CO.		Brush catalog.
94	UNITED STATES STEEL CORP., AMERICAN BRIDGE DIV.		Modern electric melting furnaces.
95	WAGNER ELECTRIC CORP.	IU-36.	Powered hydraulic crane bridge brakes.

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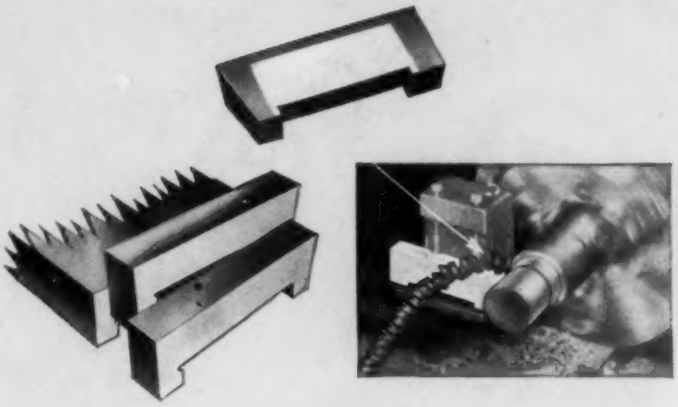
IRON & STEEL ENGINEER

1011 EMPIRE BUILDING

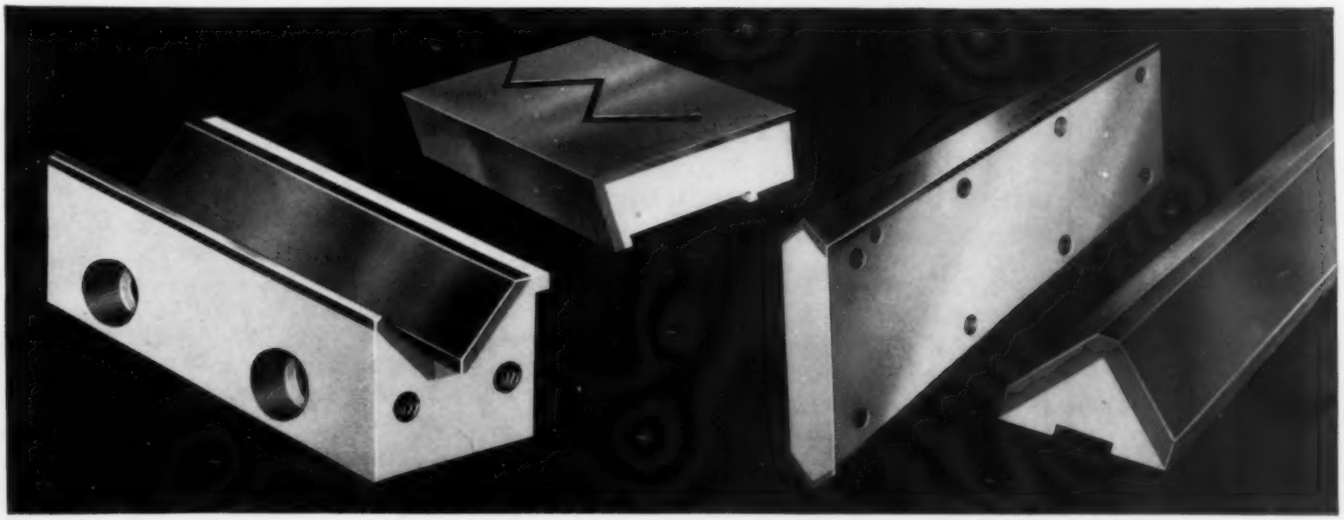
PITTSBURGH 22, PA.

to be sure they're OK



these buyers did... A group of prospective lathe buyers witnessed an amazing demonstration of OK Bedway hardness at the Gisholt Machine Co., Madison, Wisconsin. Gisholt uses OK Ways exclusively on their ram and saddle turret lathes, and to prove the quality they (1) took a section from an OK Bedway, (2) made it into a tool bit, (3) locked it in a fixture and cut spiral shavings from 1045 cold-rolled steel.

look before you buy



here's why: OK Ways are so hard they're practically wear-proof, which helps maintain constant accuracy throughout the life of the machine. In Ohio Knife's exclusive manufacturing process, long-wearing tool steel is welded to a soft steel backing under 2500 tons pressure. Then the ultimate surface hardness of the special-analysis tool steel is developed with a special heat-treating technique that is far superior to simple flame-hardening, carburizing or induction-hardening methods. The result is extreme hardness, 65-66 Rockwell "C", uniform to 3/16" in depth. Write to Dept. 31-Z for comprehensive bulletin.

Manufacturers for the Metal Working Industry of:

SLITTER KNIVES • SHEAR BLADES • ROTARY SHEAR KNIVES
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THE OHIO KNIFE CO.

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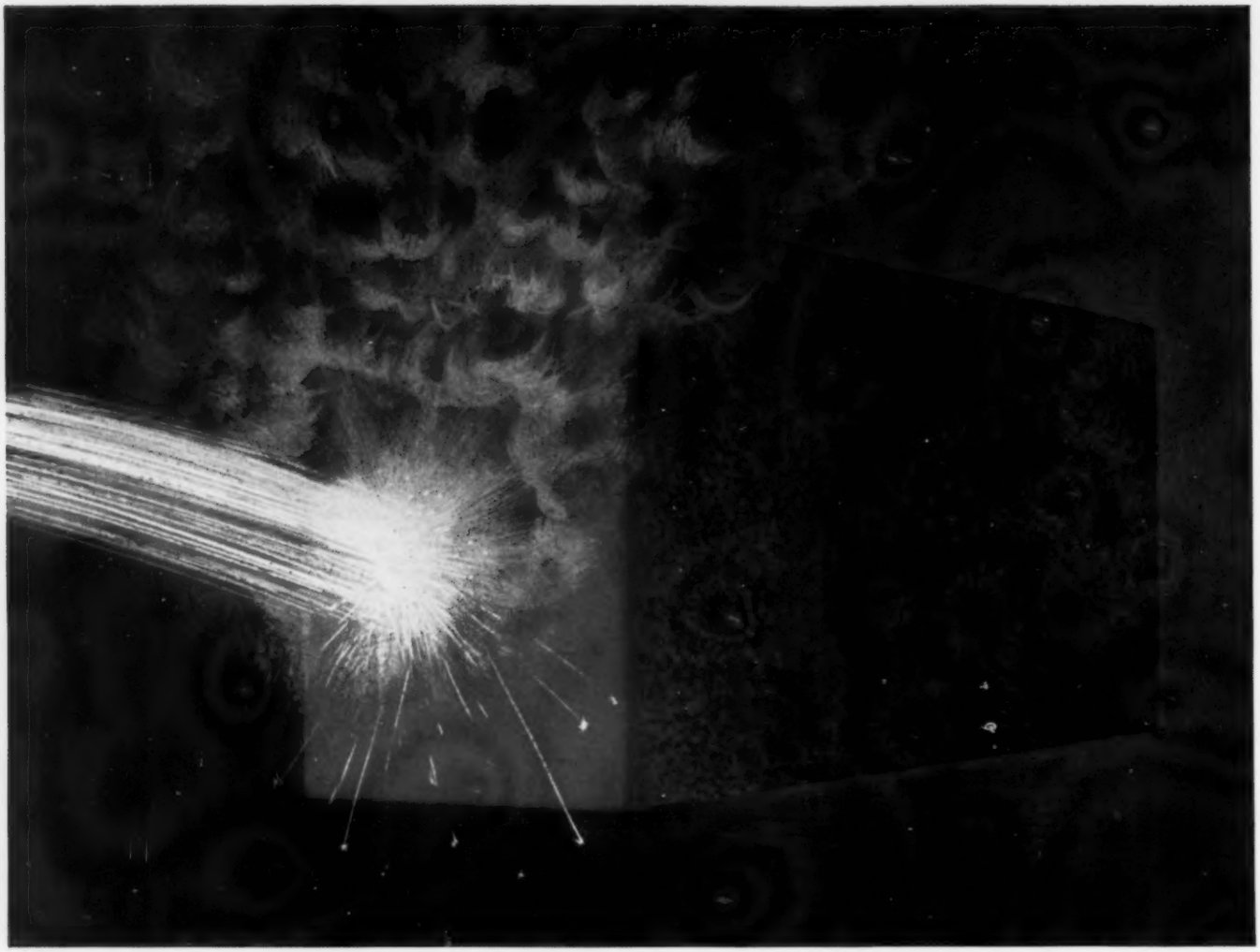


Get longer end wall life at lower cost

with Permanente Periclase-Chrome A Brick

THE SPECIAL COMPOSITION of Permanente Periclase-Chrome A Brick has greatly increased end wall life in open hearth furnaces of leading steel producers—*often with thinner walls at lower cost!*

This composition reduces spalling to an absolute minimum—even under severe attack by iron oxide in exit gases. Here are some of the reasons why Permanente Periclase-Chrome A Brick gives better service:

1. **Chromite content is the minimum amount (only 9.1% Cr_2O_3) necessary to provide thermal shock resistance, thus preventing end wall buckling.**
2. **Brick does not go through a liquid phase in forming its ceramic bond.**
3. **A ceramic bond is formed *before* the chemical bond is destroyed.**
4. **MgO content is higher than in other end wall brick.**
5. **In addition to the special composition, the brick's maximum density minimizes alteration by resisting gases and impurities.**

Let your Kaiser Chemical sales engineer show you how you can get longer life from your end walls with Permanente Periclase-Chrome A Brick. Wall thickness may often be greatly reduced with this superior brick, or *end wall life may be extended,* depending on the needs of your operation.

Call or write any of the sales offices listed below for immediate attention to your particular problem.

Call or write Kaiser Chemicals Division, *Kaiser Aluminum & Chemical Sales, Inc. Regional Sales Offices: 1924 Broadway,* OAKLAND *12, California . . . First National Tower,* AKRON *8, Ohio . . . 518 Calumet Bldg., 5231 Hohman Avenue, Hammond, Indiana* (CHICAGO).

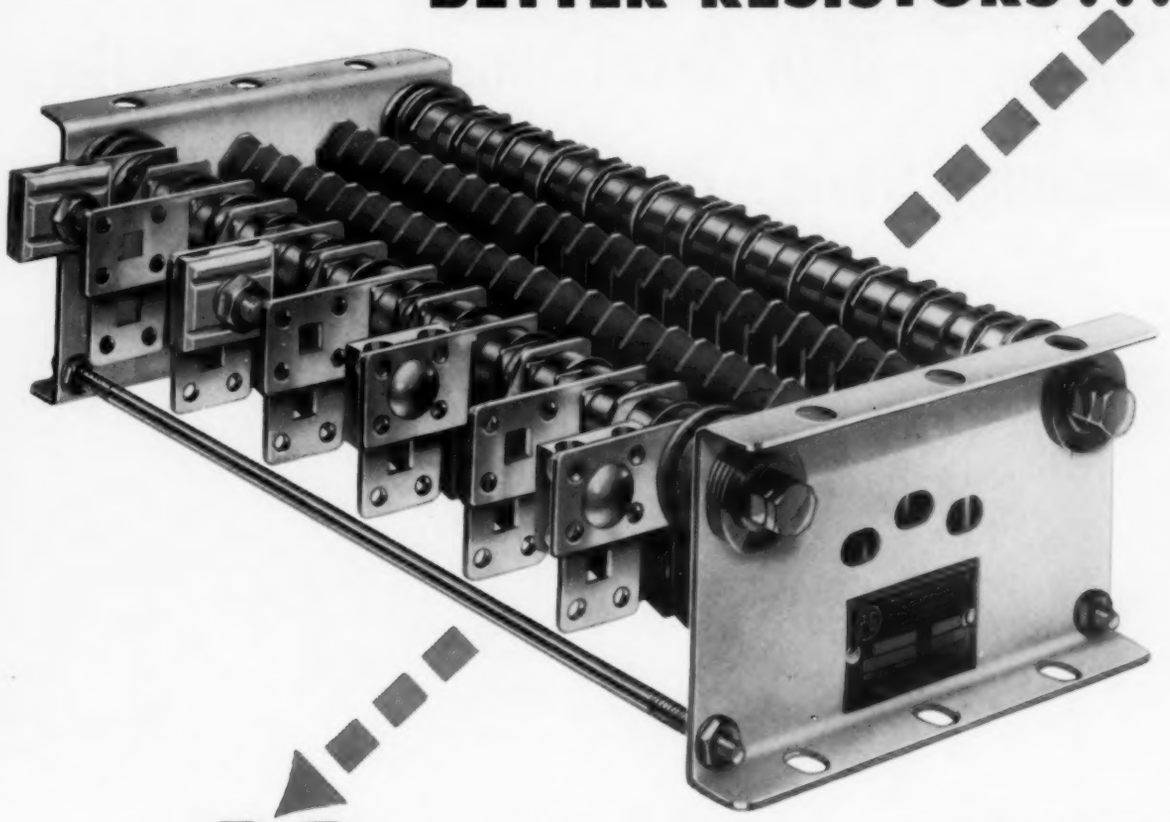
Kaiser Chemicals

Pioneers in Modern Basic Refractories

Basic Refractory Bricks and Ramming Materials • Dolomite • Magnesia • Magnesite • Alumina • Periclase

SEVERE MILL SERVICE *Demands*

BETTER RESISTORS...



P-G *Steel Grid Resistors* MEET EVERY REQUIREMENT FOR LONGER RESISTOR LIFE...

P-G has BOTH!

STANDARD Resistors

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NON-BREAKABLE • ALL STEEL CONSTRUCTION • MICA INSULATION • CORROSION RESISTANT • UNAFFECTED BY VIBRATION OR MOISTURE • PROVISION FOR EXPANSION • ADEQUATE VENTILATION • RUGGED TERMINALS

These features, plus accurate resistance values and ample capacity ratings, make P-G the *better resistor*, capable of solving your resistor problems. Specify P-G for your next application, especially, if your operating conditions are *severe*.

P-G

The Nonbreakable Steel Grid Resistor

THE POST-GLOVER ELECTRIC COMPANY

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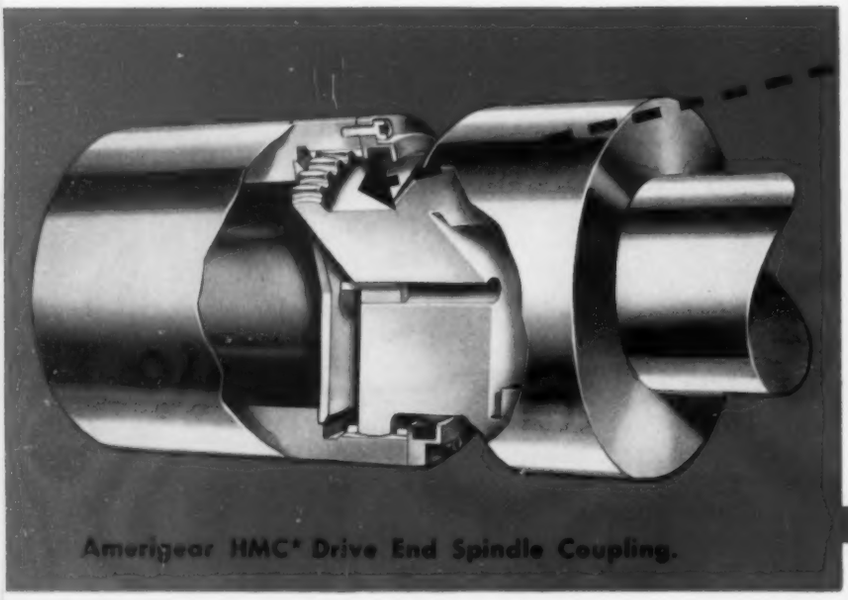
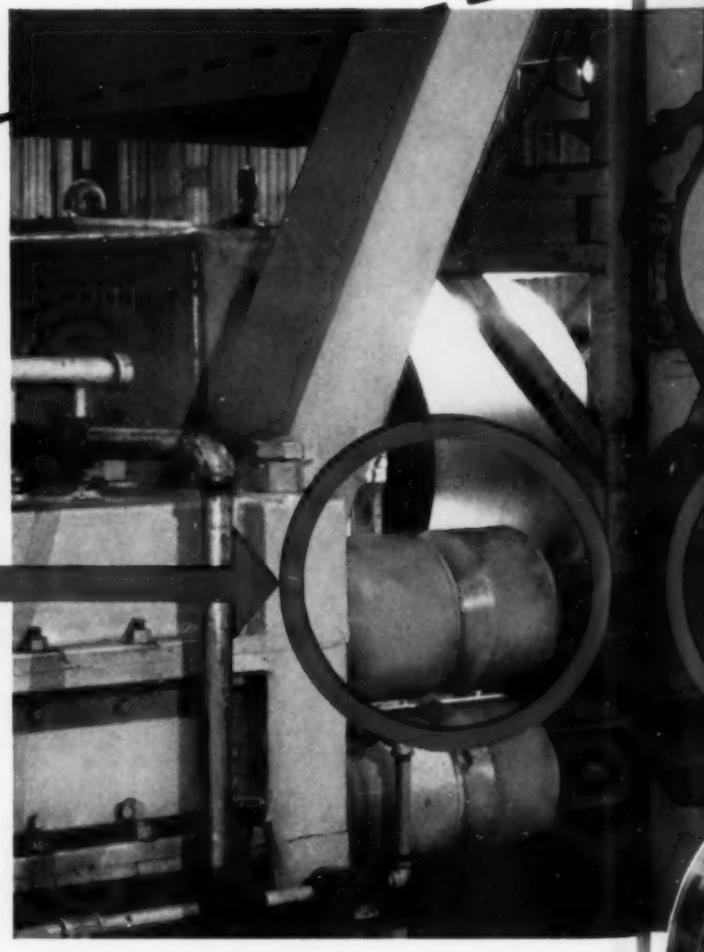
SPINDLE DRIVES Between Rolls and Pinions Obtain Optimum Operating Efficiency With *Amerigear*® High Misalignment Capacity* Gear-Type Couplings Having Patented Tooth Form Teeth



Amerigear HMC* Drive End Spindle Coupling.



4-Hi Bliss Reversing Cold Reduction Mill equipped with Amerigear HMC* Roll Drive Spindle Couplings; operating at 125 H.P. to 750 H.P., 91 to 250 R.P.M. Max. angle no load ± 4° max. angle full load ± 2°.

AMERIGEAR High Misalignment Capacity Gear-Type Couplings operate at much higher speeds, require less space, and greatly *reduce the maintenance cycle* over that of conventional type spindle roll drives. The torque load is carried on flanks of Patented Tooth Forms rather than on tooth ends. In Amerigear HMC* Couplings the engaging roll end coupling teeth are specifically modified *for quick assembly and disassembly, thus greatly reducing down time for roll changes.*

Patented Tooth Forms incorporated in Amerigear HMC* Couplings are produced from various types of steels, heat treated and hardened, depending upon operating conditions.

Amerigear Engineers are available to assist in *engineering special applications* and for adapting Amerigear Standard Type Couplings to solve your power transmission problems. Write for Catalog 501 and Bulletin 1052, or attach coupon to your business letterhead.

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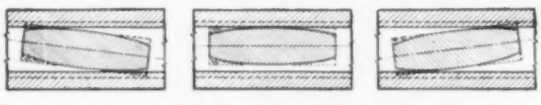
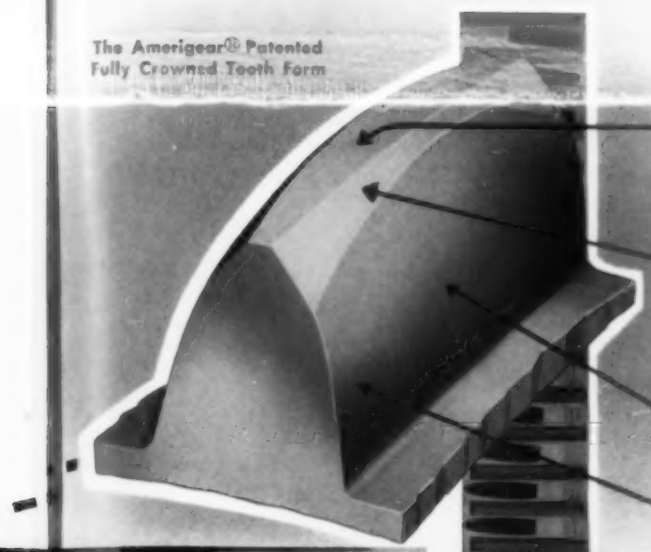


Comparison with gearing of conventional gear-type couplings shows how the Patented Amerigear Tooth Form eliminates *tooth end loading* and simultaneously allows for higher misalignment capacity for both lateral and angular misalignment. Dotted lines indicate gear teeth of conventional gear couplings.

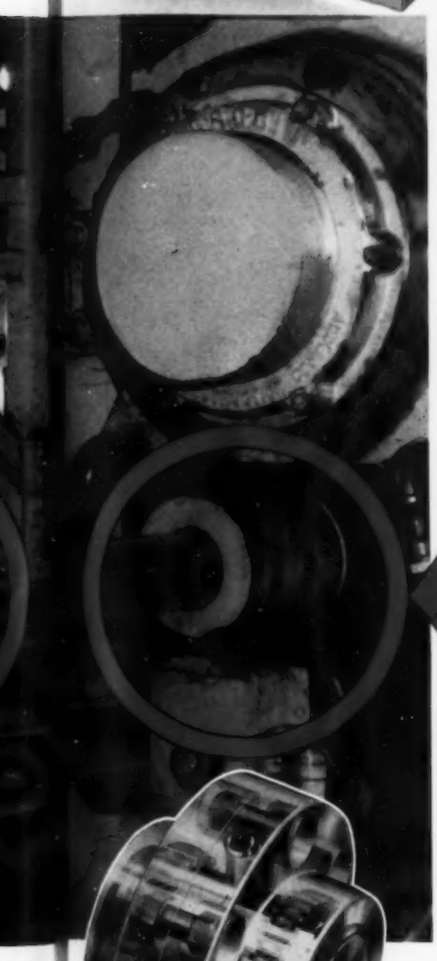
The Amerigear® Patented Fully Crowned Tooth Form



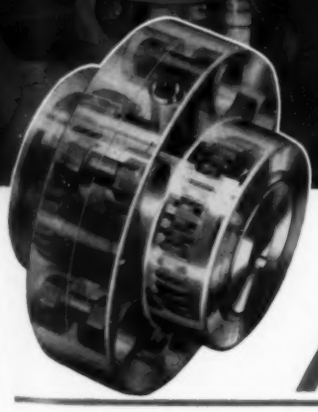
Crowned Tip contacts root of internal gear tooth in sleeve, accurately piloting sleeve with a ball and socket action.

Chamfered to eliminate interference with sleeve tooth fillet and allow contact on true flank of gear tooth.

Crowned flank carries all the load and provides correction of lateral and angular misalignments.



Amerigear HMC* Roll End Spindle Couplings.



Illustrating Full Cycle Misalignment Pattern of Amerigear H.M.C.* Patented Tooth Form.

All parts of Amerigear HMC* Flexible Couplings are Parco Lubrite processed for increased wear and corrosion-resistance. The assembled coupling is essentially a dust and moisture-proof unit due to positive hub oil seals. The oil seal assures continuous operation for years with the original lubricant.

Amerigear®

HMC* FLEXIBLE COUPLING

One of several Standard Types embodying the Patented Amerigear Tooth Form
Patented and Patents Pending

AMERICAN FLEXIBLE COUPLING COMPANY
ERIE, PA., U. S. A.
Affiliate: J. A. Zurn Mfg. Co.
SALES OFFICES IN PRINCIPAL CITIES OF THE WORLD
In Canada: Canadian Zurn Engineering Ltd., 2052 St. Catherine St., W., Montreal 25, P.Q.

AMERICAN FLEXIBLE COUPLING COMPANY
ERIE, PA. U.S.A.

Please send me further information regarding AMERIGEAR COUPLINGS with the Patented Fully Crowned Tooth Form as described in Catalog No. 501 and Bulletin 1052.

Name ..... *Title* .....

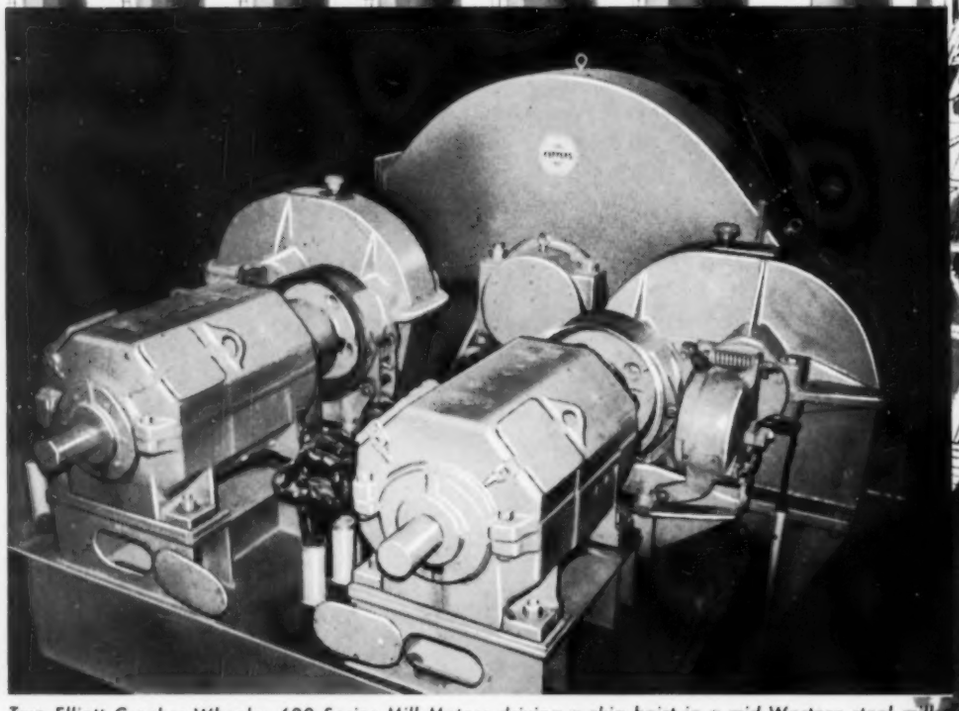
Company .....

Address .....

City ..... *Zone* ..... *State* .....

Please attach to your business letterhead. Dept. ISE 617

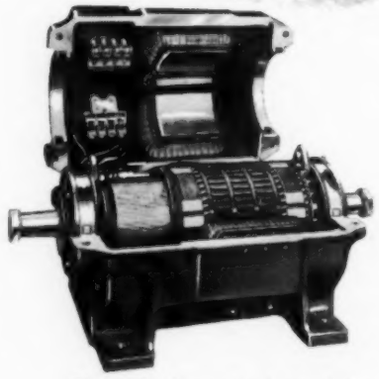
Giving a lift to steel mill skip hoists . . .



Two Elliott Crocker-Wheeler 600 Series Mill Motors driving a skip hoist in a mid-Western steel mill

ELLIOTT C-W MILL MOTORS

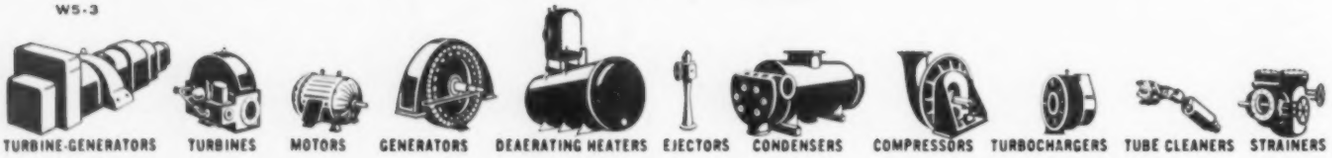
These dependable motors are naturals under rugged, heavy duty operations. They stand up to punishing overloads, constant starting and stopping, reversing strains, etc., and come back for more every time. Their compact durability plus advanced engineering features assure greater power per standard frame size. The tough cast-steel frame is split for easy access to armature, bearings, and field coils. Standard 600 series motors can be readily adapted to separately forced-ventilated, protected self-ventilated or built-in back gear types. For details, ask your local Elliott field engineer, or write for the Mill Motor Bulletin. Address Elliott Company, Crocker-Wheeler Division, Jeannette, Pa.



The split frame is hinged for easy access to all motor parts.

ELLIOTT Company

WS-3



TURBINE-GENERATORS · TURBINES · MOTORS · GENERATORS · DEAERATING HEATERS · EJECTORS · CONDENSERS · COMPRESSORS · TURBOCHARGERS · TUBE CLEANERS · STRAINERS

Equipment News...

BLAST CLEANING UNIT

▲ Development of Model ES-492 Rotoblast machine is announced by Pangborn Corp. This machine cleans both sides of steel sheet and plate simultaneously, in widths up to 60 in., at a cleaning rate of 60 to 100 sq ft per side per minute.

This machine has been designed to meet the requirements of manufacturers who must have steel sheet which has been cleaned on both sides. Blast cleaning provides a better bonding surface for paint, welding or forming. It also reduces production costs by making it possible to use hot rolled steel (blasted clean) rather than cold rolled sheet or pickled sheet. The ES-492 is equipped with four standard Rotoblast wheels which are capable of throwing 112,000 to 132,000 lb of abrasive per hr.

The unit takes steel sheet or plate into the blast chamber automatically, blasts the top and bottom surface simultaneously at a single point, removes all abrasive from the sheet, and discharges it from the machine. An important feature of the blasting operation is the fact that the blast streams from top and bottom hit the sheet at exactly the same point so there is little tendency for the sheet to warp.

The abrasive is blown off the sheet as it moves past a fan tunnel after blasting. It drops into the machine hopper and is carried up to the separator by an elevator. Scale dust and broken-down abrasives are removed from the abrasive after which it is returned to the Rotoblast wheels for re-use.

A design feature of the machine is the fact that the Rotoblast wheels are set over 12 deg from the vertical causing the abrasive to strike the sheet at a 78 deg angle. This angle impact not only cleans faster and better but makes the abrasive bounce away from the point of impact so that the continuing abrasive stream strikes the sheet and not spent abrasive.

Another feature contributing to minimum maintenance is the arrangement of idler rolls on the work conveyor drive. The rubber covered rolls which carry the steel sheets through the blast machine are not driving rolls and can be lifted out through access doors and replaced, if necessary.

Standard blasting equipment for the ES-492 comprises four 195-3-RG wheels (five in. vane) each of which is powered by a 20 or 25 hp, 1800 rpm motor. Other four wheel machines are available using five in. wide vanes and 40 hp motors to drive the Rotoblast wheels. These machines provide more than double the cleaning capacity of the ES-492. Special machines can be developed for production requirements that are even greater.

RATE RECORDER

▲ The Electric Tachometer Corp. announces an improved rate recorder which makes permanent records of speed or production rates as well as totalizing the production units on an integral counter.

The recorder chart may be calibrated in any function of speed, and is wax-coated and inscribed with a precision carboloy stylus, eliminating the trouble and expense of servicing ordinary pen-and-ink, ribbon, or carbon paper marking devices.

Controlled by a rotary contactor and a specially-designed electric clock, the recorder gives immediate visual information for control or maintenance purposes, and provides a recorded basis for analysis of production, breakdown causes, speed tolerances, piecework payroll, and numerous other factors contributing to operating efficiency.

The contactor, mounted on the machine whose speed is being measured, requires very low torque and can be driven in exact ratio to production through spur gears, chain-and-sprocket, or by friction contact with the moving product. The accuracy of the recorder is independent of machine vibration or wear, electric supply voltage, or length of connecting leads.

STATOR NEARS END OF CROSS-COUNTRY JAUNT

Moving this massive electric generator stator from the General Electric Co.'s turbine factory in Schenectady, N. Y., to the Pacific Gas and Electric Co.'s power station now under construction at Morro Bay, Calif., involved the use of an eight-axle freight car, an 82-wheel trailer, and enough lumber for a six-room house. The 18-day cross-country railroad trip ended at Camp San Luis Obispo army base siding between San Luis Obispo and Morro Bay — nine miles from the powerhouse site. The load was transferred from the 16-wheel low-bed flat car to a specially-built, highway-type, tractor-trailer combination. Every foot of the nine miles of state highway between the base and the plant site had to be covered with planks to protect the pavement.

THIS RAMTITE PERFORMANCE

WARRANTED THE 2ND & 3RD INSTALLATION OF A RAMITE FANTAIL & CHECKER CHAMBER ROOF

This Ramtite Fantail and Checker Chamber Roof, shown here as it nears completion, was superior in service — good enough to make the customer want a second and third installation in other furnaces. After one year's service, the roof and the arch, to quote the customer, "Looked good," and the next installations were started.

The many economies effected with the use of Ramtite — lower inventory, easier installation, longer life, and more dependable service — explain the ever increasing use of Ramtite Refractory Products in Industry. Can you afford not to use it?

RAMTITE IS OUR BUSINESS — NOT OUR SIDELINE. Our experience in this particular field — over 30 years — qualifies us as experts in the applications of plastic refractories.

Contact your local Ramtite Representative or send us the attached coupon for more data on this newest engineered material for versatile refractory construction.

THE Ramtite CO.
Division of the S. Obermayer Co.
1813 South Rockwell Street, Chicago 8, Illinois

PLEASE SEND ITEMS CHECKED:
☐ Bulletin on Castable and Gunning Refractories
☐ Steel Plant Catalog

Company Name _____
Attn. Mr. _____ Title _____
Address _____
City _____ Zone _____ State _____

This is another in a series of advertisements depicting the ways in which Ramtite Refractories can be of service in the steel industry.

A chart coding device can be used to record causes of breakdowns or stoppages, or other information such as what product was moving through the machine at a given time.

MAGNET

▲ A light-weight, 45-in. lifting magnet, weighing 3200 lb, designed to speed up material handling on scrap yard boom cranes has been developed by The Electric Controller & Manufacturing Co.

The manufacturer's test records show that, due to the faster maneuverability and more trips per day, an increase of eight to 10 per cent in net tonnage handled can be expected. The test also brought out the ability to lower the boom to cover a wide radius without moving the crane.

FLOW VALVES

▲ Askania Regulator Co. has developed a series of constant flow valves that maintain the rate of flow of fuel oil or any other non-abrasive fluid within one per cent up to 200, 300, 400, 500, 600, or 700 gph as desired.

Each model will maintain flow rates as low as 10 per cent of maximum. The valves will regulate the flow of fluids with viscosities as high as 250 ssu at operating temperature, static pressures as great as 500 psi, and temperatures as high as 250 F, despite fluctuations in upstream or downstream pressure. Flow level is accurately maintained as long as the fluid viscosity and temperature are constant and the pressure differential across the valve is 40 psi or higher for maximum flow.

Flow level may be set manually at the valve or through any one of four optional remote adjusting systems

specifically designed to operate in conjunction with the valve. These four systems, one hydraulic, one pneumatic, and two electric, may in turn be operated manually or by a pneumatic, or electric signal proportional to temperature, flow of another fluid or a gas, or some other variable. In addition, any one of these adjusting systems may incorporate a feedback potentiometer to develop a voltage proportional to flow through the valve.

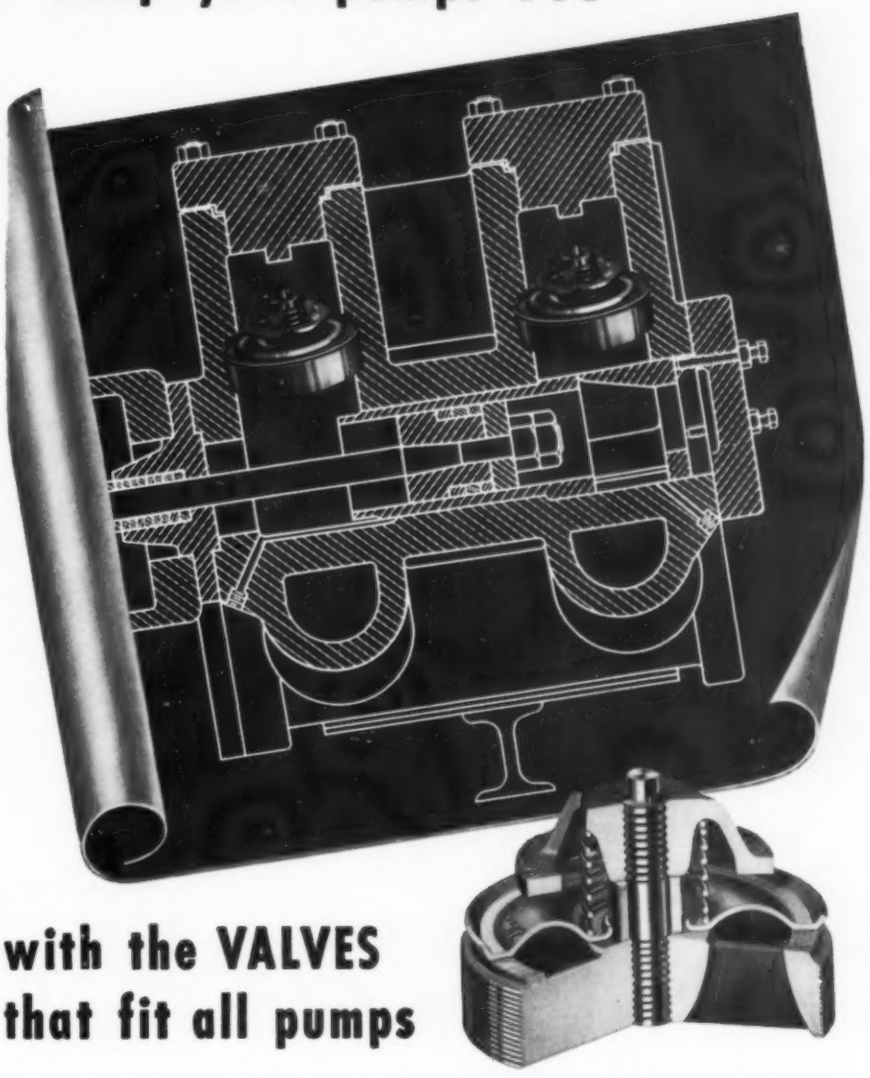
The constant flow valve operates by measuring the pressure drop across an adjustable orifice. This pressure differential is applied across a spring-biased hydraulic cylinder connected to operate a throttling valve upstream from the orifice. If the pressure drop across the orifice does not exactly balance the constant force applied by the spring, the resultant piston action causes the throttling valve to re-adjust differential pressure at the orifice to the desired valve, and, consequently, flow to the preset rate.

HI-SPEED GEAR UNIT

▲ A completely new and improved line of hi-speed gear units for speed reduction and increased service has been introduced by the Philadelphia Gear Works, Inc. Rotating speeds up to 9000 rpm and pitch line velocities to 10,000 fpm can be accommodated without modification.

Gearing is of the double opposed helical type having teeth hobbed and precision shaved. Opposed helices completely eliminate thrust forces against bearings and housing. Gearing is dynamically balanced to provide vibration-free power transmission at even the highest rotating speeds. All gearing is manufactured to the latest recommended practices of the American Gear Manufacturers Association.

Keep your pumps FIT



with the VALVES that fit all pumps

Your old reciprocating pumps can be rehabilitated or adapted to new and severe service by fitting them with DURABLA Pump Valve Units.

The patented corrosion-resistant, non-warping, pressed metal valve, making only "point contact" on the stud or sleeve, cannot bind or hang up on the guard stem. The open-type guard assures free flow of liquid and eliminates any possibility of spring clogging from hardening liquids.

DURABLA Pump Valves will operate freely under extremes of high or low temperature, with highly corrosive fluids, and in any position. They will handle vacuums of one micron or discharge pressures of thousands of pounds per square inch.

Standard equipment on many pumps, DURABLA Valve Units are made in fifteen sizes, designed to meet over 300 variations in installation requirements. They will fit any reciprocating pump, new or old.

A DURABLA engineer will be glad to help you work out a plant survey covering your valve requirements. Write for bulletin or engineering assistance.

DM-2

DURABLA

DURABLA MANUFACTURING COMPANY

114 LIBERTY STREET • NEW YORK 6, N. Y.

Rugged housings include ample oil reservoir, integral pump and coolant system with spray nozzles directed at the line of gear contact.

Bearings are of the babbitted bronze type, centrifugally cast for uniformity of grain structure.

MAGNET

▲ Designed especially for use with mobile or overhead gantry cranes, a new high-capacity, lightweight lifting magnet is announced by the Ohio Electric Manufacturing Co.

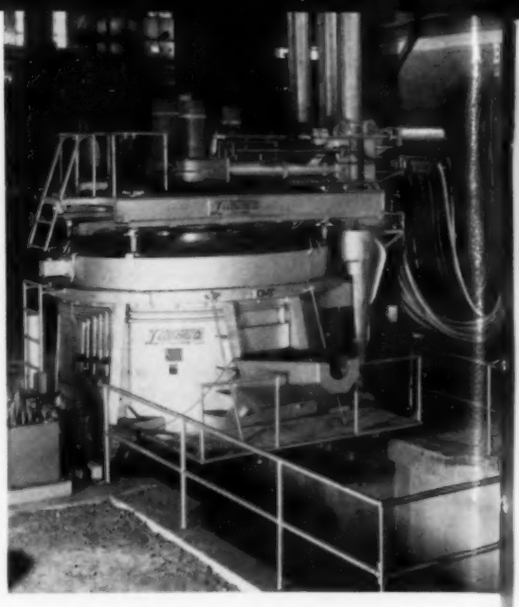
The new magnet weighs only 3400 lb compared to approximately 3750 lb for a conventional type magnet.

Protecto-Weld construction, wherein the outer ring and top plate are welded together on the top of the magnet, is featured on the new unit. This method places the weld in a position where it cannot be cracked or damaged by frequent blows against the outer ring, principal cause of weld failure in conventional magnets. By eliminating danger of cracks in the weld, the magnet remains hermetically sealed against moisture indefinitely. Lifting coil repair or replacement is a simple matter since the weld can be removed in a large lathe. So-called "capsule-coil" construction is available if desired.

RECORDER INK

▲ The Foxboro Co. has developed a new general purpose ink for use with the company's complete line of industrial recording instruments. Designated as Type 1500 ink, it was especially formulated for use with Foxboro pens and Humitex charts to produce the sharpest possible record of a process variable.

The new ink contains no sediment, is smooth flowing, will not clog the pen, and dries quickly without feathering the chart. Special properties



ELECTRIC ARC FURNACE

This $300,000 electric arc swing-roof type furnace, installed at the Birdsboro Steel Foundry & Machine Co. at Birdsboro, Pa., will enable the company to move into the alloy steel casting field. Birdsboro, which until now has produced primarily carbon castings, announced that it intends to turn out an increasing volume of high quality, alloy steel castings in many sizes and analyses. The furnace shell is 11 ft in diameter. Capacity is 20 tons per heat, or approximately 125 tons per day.

NEW *Aerovent* *Vaneaxial* FANS

for peak efficiency and economy in all higher static pressure ranges

Designed for maximum operating performance and low-cost, easy maintenance, Aerovent "Vaneaxial" Fans utilize specially constructed propellers and guide vanes to provide high-velocity, straight-line air delivery. Available in sizes 12" to 48" for capacities to 77000 CFM.

other models for every air-moving requirement

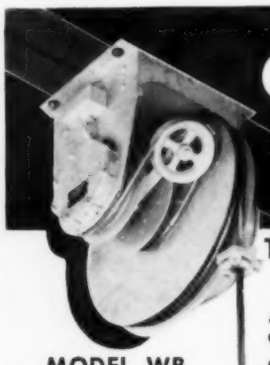
Certified Ratings

All Aerovent Fans are rated in accordance with the Standard Test Code and U.S.D.C. Comm. Std. CS178-51.

Ask for free folder V-50!

Aerovent Fan Company, Inc.

Ash and Brook Streets *Piqua, Ohio*



GLEASON REELS

The Model WB *positively eliminates*

- UNDUE CABLE TWIST
- SLIDING CONTACTS AND COLLECTOR RINGS
- UNNECESSARY CABLE LENGTH
- EXPLOSION HAZARDS

MODEL WB

A spring driven reel to take up and pay out electric cords and cables. Used with portable or movable communication or instrumentation equipment which would be adversely affected by the varying resistance of sliding electrical contacts or where undue twisting of cords or cables cause varying capacity. Outstanding applications include pyrometers and crane scales. Also for use in hazardous locations where electrical parts would require dust-tight or explosion proof protection.

ALL-STEEL WELDED CONSTRUCTION

BALL BEARINGS — for smooth, friction-free action.

SPRINGS — best spring steel, mounted outside spool in dust-tight housing. Easily accessible for service or inspection.

TWO-WAY PAYOUT—design permits cable to pass around spool from one side to the other as center of travel is passed. This prevents bends in the cable and requires cable length to be only one-half the length of travel.

SEND FOR LITERATURE DESCRIBING THE COMPLETE GLEASON REEL LINE

Gleason Reel Corp

Subsidiary of Maysteel Products, Inc.

Room 706

740 N. Plankinton Ave. • Milwaukee 3, Wisconsin

DREVER
Continuous
PLATE HEAT TREATING LINES
Integrated high capacity heat treating lines, featuring the pressure quench, produce FLAT high quality plate . . . .
DREVER

A BIG INVESTMENT

TO GIVE YOU THE UTMOST IN HEAVY DUTY GEARS

"Industrial Gear"

New Hobber producing tip-relieved tooth form Gears that prevent interference under Heavy Load offering increased service life.

Our shop is fully equipped to produce Gears of all types from Herringbone to Spurs. We cut from your stock or furnish gears complete including splining and sprockets.

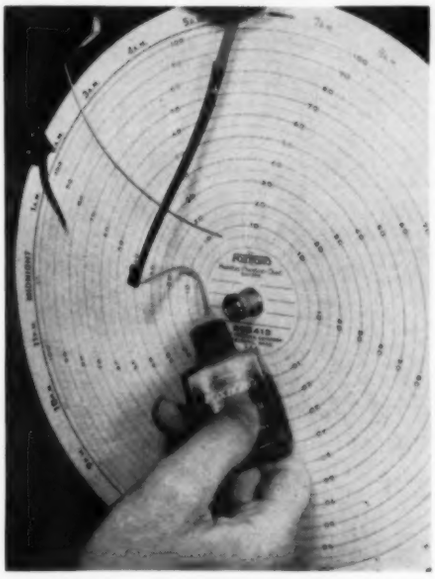
Specify "IG-Durocase" (Steel Mill Type Gears or "IG-General Service Gears"). Our facilities and abilities await your orders.

IG GEARS — DUROCASE GEARS — MEMBER OF AGMA

Industrial Gear Mfg. Co.

4527 W. VAN BUREN ST.
CHICAGO 24, ILLINOIS

give it a wide range of performance under varying industrial conditions. It is rated for high temperature, and can also be used down to 0 F.



For convenience in inking the pen, Type 1500 ink is furnished in a newly-designed one-oz polyethylene squeeze bottle. An exclusive plastic capillary tube and filter assembly enables the user to pinpoint a precise quantity of ink on the pen without dripping it on chart or instrument. Box pens can be tube-filled through the point and need no additional priming prior to use. The bottle is quickly sealed for leakproof storage by inserting the tip of the filling tube into a receptacle in the closure.

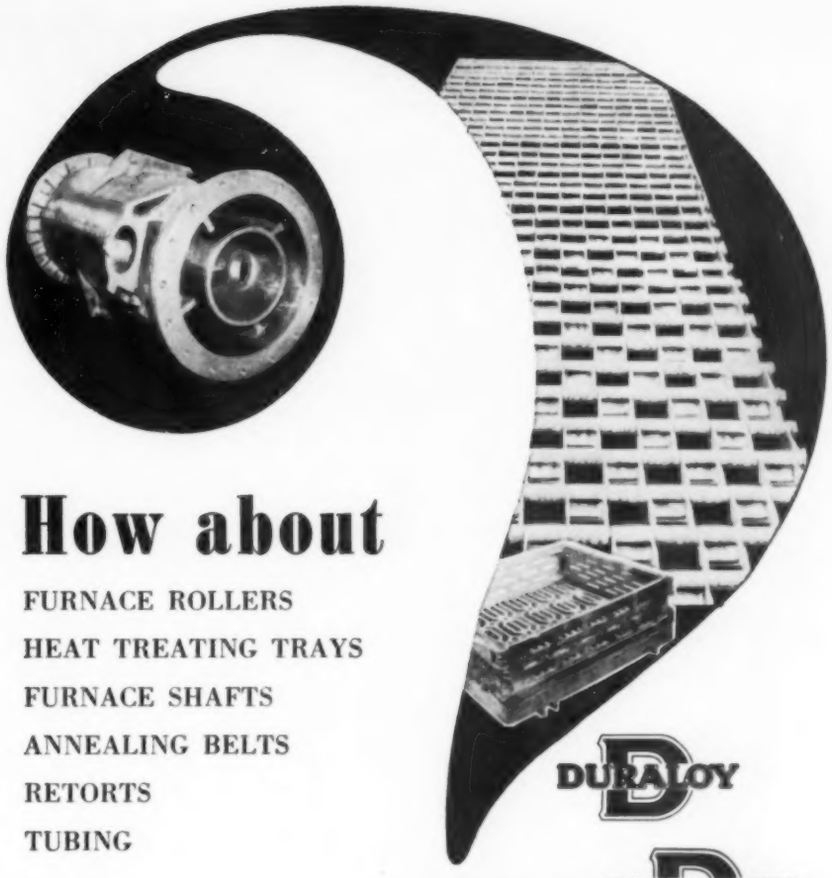
The new ink in the unbreakable plastic dispenser is furnished in red, violet, blue, green and black.

LIMIT SWITCH

▲ Designed for long life with minimum maintenance and greater ease in wiring, a new heavy-duty machine limit switch, introduced by the Clark Controller Co., features increased wiring space, protection against excessive overtravel without shear pins, complete separation of electrical and mechanical mechanisms, and nylon-to-steel wearing surfaces.

The switch is conservatively rated at 10 amperes continuous capacity up to 600 volts ac, 550 volts dc. The switch is available with ½ or ¾ in. conduit connections.

The Type DM limit switch has a heavy diecast case with an integral solid wall separating mechanical and electrical mechanisms. On the electrical side, a heavy one-piece molded insulating chamber surrounds all live



How about

FURNACE ROLLERS
HEAT TREATING TRAYS
FURNACE SHAFTS
ANNEALING BELTS
RETORTS
TUBING

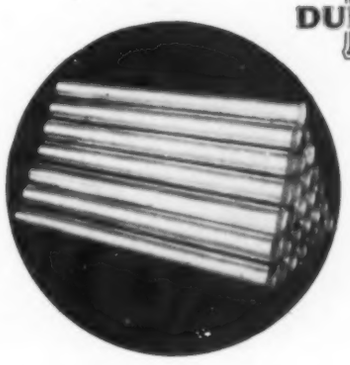
DURALOY

DURASPUN

Which are
Heat Resistant

Corrosion Resistant

Abrasion Resistant



When ready to order, how about checking with us here at DURALOY? For more than thirty years we have specialized in high-alloy castings. In fact, we were among the first to produce static castings and the first to produce centrifugal castings. We are old hands at producing castings alloyed to fit each specific requirement and to finish them to any extent desired.

Melt, castings and finishing are carefully controlled and quality tested by our staff of metallurgists, chemists, X-ray and gamma-ray technicians. If you would like more preliminary information, send for Bulletin No. 3150-G

THE DURALOY COMPANY

Office and Plant: Scottdale, Pa. · Eastern Office: 12 East 41st Street, New York 17, N.Y.

Detroit Office: 2990 Woodward Avenue · Pleasant Ridge, Mich.
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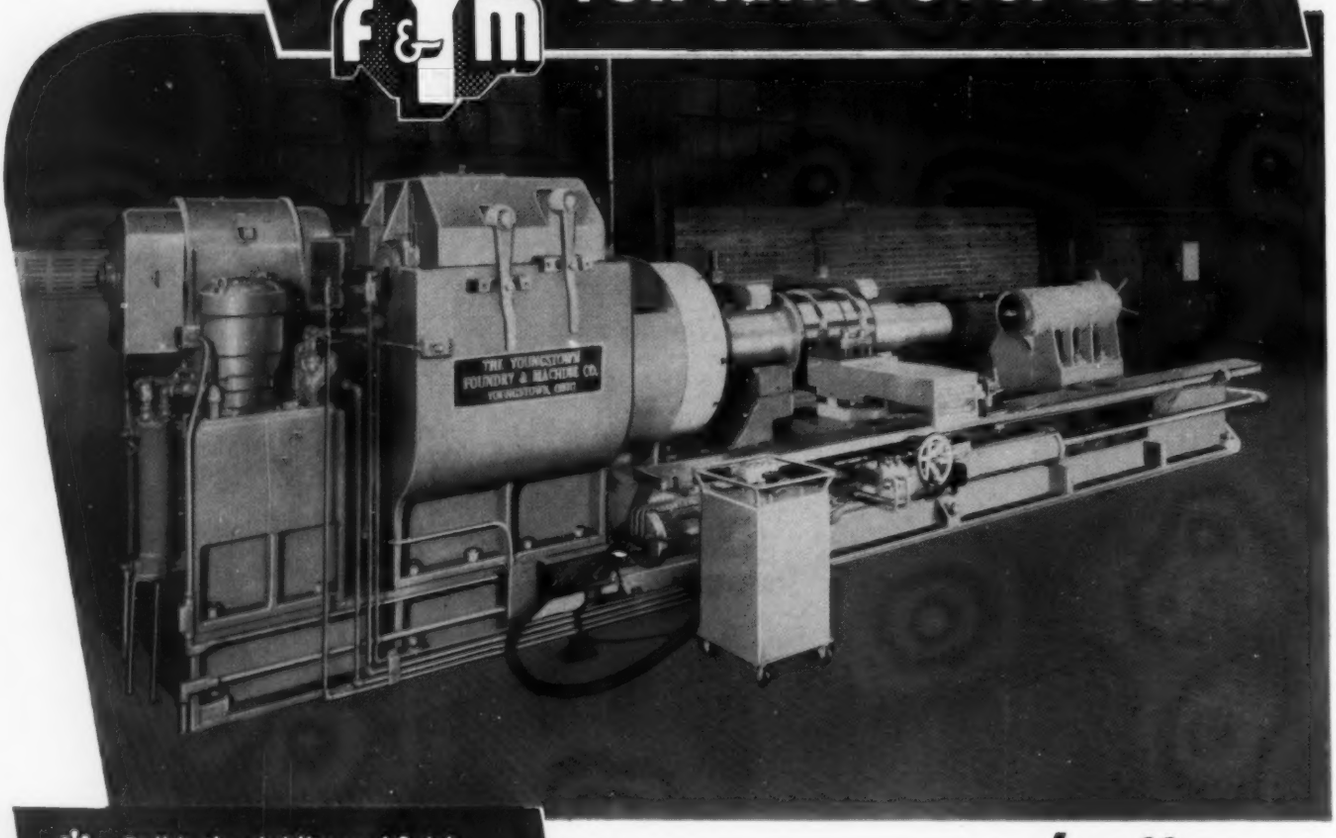
METAL GOODS CORP. Dallas · Denver · Houston · Kansas City · New Orleans · St. Louis · Tulsa

NOW the most efficient * roll lathe ever built



* *Roll Lathe rigidity and finish with Engine Lathe speed and flexibility*

* *Completely hydraulic tracer control insures smoother, more accurate finish*

* *Tool post and carriage designed to use either single point carbide-tipped tools or regular roll turning tools*

* *Ways on carriage and tail stock are non-metallic, which greatly extends service life*

* *Timken roller bearings throughout; herringbone gearing; automatic lubrication*

You can turn rolls *better...* either on necks or centers

WITH THIS

New "YOUNGSTOWN"

36" Contour Roll Lathe

Outstanding in performance! Tested! Proved! This lathe, originally developed and perfected for turning in our own roll shop, turns rolls either on necks or centers. Speed range .75 RPM to 53.5 RPM. Roll capacities: 6" minimum diameter, 36" maximum diameter, with 11'6" maximum length (subject to alterations to suit your specific needs). Your next Roll Lathe if you want the best.

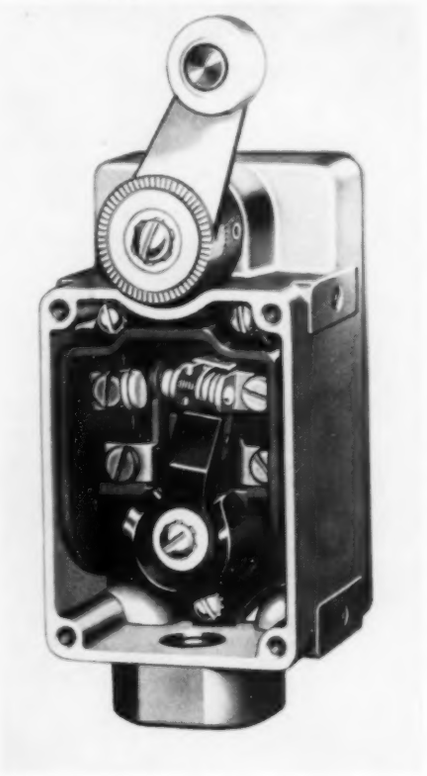
Write for Complete Information

The Youngstown Foundry & Machine Co.

SERVING INDUSTRY SINCE 1885

Youngstown, Ohio

parts, supports wiring terminals, and shrouds the moving contact arm to prevent fouling by wire leads. Need for use of insulating cloth is eliminated. The inside of the front cover plate and separating wall are protected against arc deterioration by non-carbonizing glass melamine.



The mechanical side is rugged, with a minimum of moving parts. All bearing surfaces in latch and trip mechanisms are nylon-to-steel, selected for low coefficient of friction and long wearing qualities. The operating arm roller is also nylon.

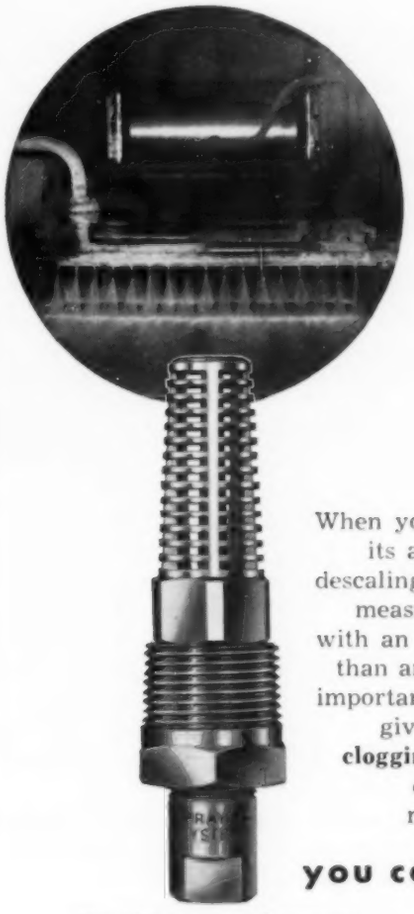
The overtravel mechanism has two sets of double-concentric coil springs permitting continuous 30 deg overtravel without increasing maintenance problems or shortening life. These and all other springs are in compression to make operating as nearly "fail safe" as possible. Excessive overtravel is accommodated by slippage between mating serrated discs. Pressure required to slip these discs is many times the normal operating pressure of the switch, but well below that which could damage switch parts. After excessive overtravel the switch can be reset with a screwdriver, with no replacement of parts necessary.

An infinite variety of front and reverse-lever mounting arrangements can be made with six optional back cover plates. Eight types of operating levers are available, including four lengths of straight levers, and track-type, planer-type, and shipper rod arms.

ARC WELDER

▲ A new universal, combination arc welder which provides a choice of either ac or dc welding current has been introduced by the Lincoln Electric Co. The new machine, called the "Idealarc," is said to provide an ideal type of welding arc for every type of manual welding application, permitting selection of either ac or dc and either a soft or forceful arc.

The "Idealarc" is said to present a unique opportunity for welders to select the proper welding arc for their application. The machine is available in several combinations. It can be obtained as an ac welder without the dc current. To this unit a dc package can be easily attached in



SPRAYING SYSTEMS

descaling

SPRAY NOZZLES

for performance *in full measure*

When you consider performance in all its aspects, here are spray nozzles for descaling that give outstanding full measure. Descaling itself is carried out with an efficiency as high as or higher than any other nozzle made. But equally important, Spraying Systems nozzles give you low first cost . . . **plus non-clogging design** that **reduces** the costs of down-time and maintenance to a minimum.

you can SEE the difference

Thin, high-impact, uniform spray

Open, elliptical non-clogging orifice

The thin, concentrated, uniform spray strikes with greatest possible impact for any volume and pressure . . . descales without excessive sheet cooling.

Clogging is practically eliminated by *elliptical*-shaped orifice . . . foreign matter goes right through.

CHOICE OF SIZES . . . offered in 16 different capacities . . . for every known descaling use.

Designed and manufactured by America's leading producers of industrial spray nozzles. For complete information write for Data Sheet 6120.

SPRAYING SYSTEMS COMPANY 3262 Randolph Street Bellwood • Illinois

Spray Nozzles also supplied for such applications as Run-Out Table Cooling . . . Roll Cooling . . . Cooling Ingot Molds and many other uses. For complete information write for Catalog No. 24.

Hyde Park

RED CIRCLE Rolls ALLOY-CHILLED

Red Circle Rolls for all Purposes

Hyde Park Red Circle Rolls are outstanding in quality and in performance and are easily identified by the Red Circle.

for
finer finish
long life
greater tonnage
Specify Red Circle

Chilled Rolls
Alloy Iron Rolls
Moly Rolls
Nickel Chilled Rolls
Grain Rolls
Cold Rolls
Sand Rolls

Hyde Park
FOUNDRY & MACHINE CO.
Hyde Park, Westmoreland County, Pa.
ROLLS
ROLLING MILL MACHINERY
GREY IRON CASTINGS

about one hour whenever desired. It is also available as a combination ac and dc machine with selection of either current made through a simple twist of a switch handle. Different output capacities of dc and ac can be combined to fit the machine to the job requirements. The machine thus can be quickly set for maximum efficiency on every type of welding; ferrous or non-ferrous materials, sheet metal or heavy plate, all positions, and under arc blow conditions or poor fit up.

For ac welding jobs the machine provides a single phase transformer type welder, the circuit of which has been designed to give greater arc stability than is normally associated with welding transformers. The machine is said to produce an exceptionally smooth spray type of transfer of metal.

Both voltage and amperage are controlled to give the desired control of arc characteristics. The "Idealarc" provides continuous current control through a rotating core in a separate control circuit and also has a switch to permit control of the open circuit voltage. Through this voltage control, the arc can be made to be either a soft arc, steady, low in spatter with a spray type of metal transfer, or it can be made a forceful digging arc with maximum penetration for crowding the arc without a tendency for electrode sticking.

In addition to dual-control of the arc, the machine also has an arc booster switch for selecting normal or "hot" starting. The machine's inherent stability provides unusually good ac current starting characteristics, but the switch permits controlling this to give efficient performance on different types of materials, in varying thicknesses and under different joint conditions.

The new machine, it is claimed, will permit using, to their maximum advantage in speed and quality, the new iron powder type electrodes which are designed for best performance with ac current.

For dc welding, the Idealarc provides dc welding current through heavy duty rectifiers. Dual-control of the arc is provided and, in addition, ability to select either normal or "hot" starting with the arc booster. This is the first time choice of arc starting characteristics has been made available on dc welders. The

Specify Adalet for

Vapor-tight Fixtures

With The Guard
You Just Lift And Twist
To Install

These Bayonet-Lock cast aluminum guards are just one of the many "extras" you get when you specify Adalet Vapor-tight fixtures.

Four tapped hubs and three plugs are standard.

Available with reflectors in sizes up to 500 watts... *complete fixture package in one box.*

Send for Bulletin E

Name_____
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Company_____
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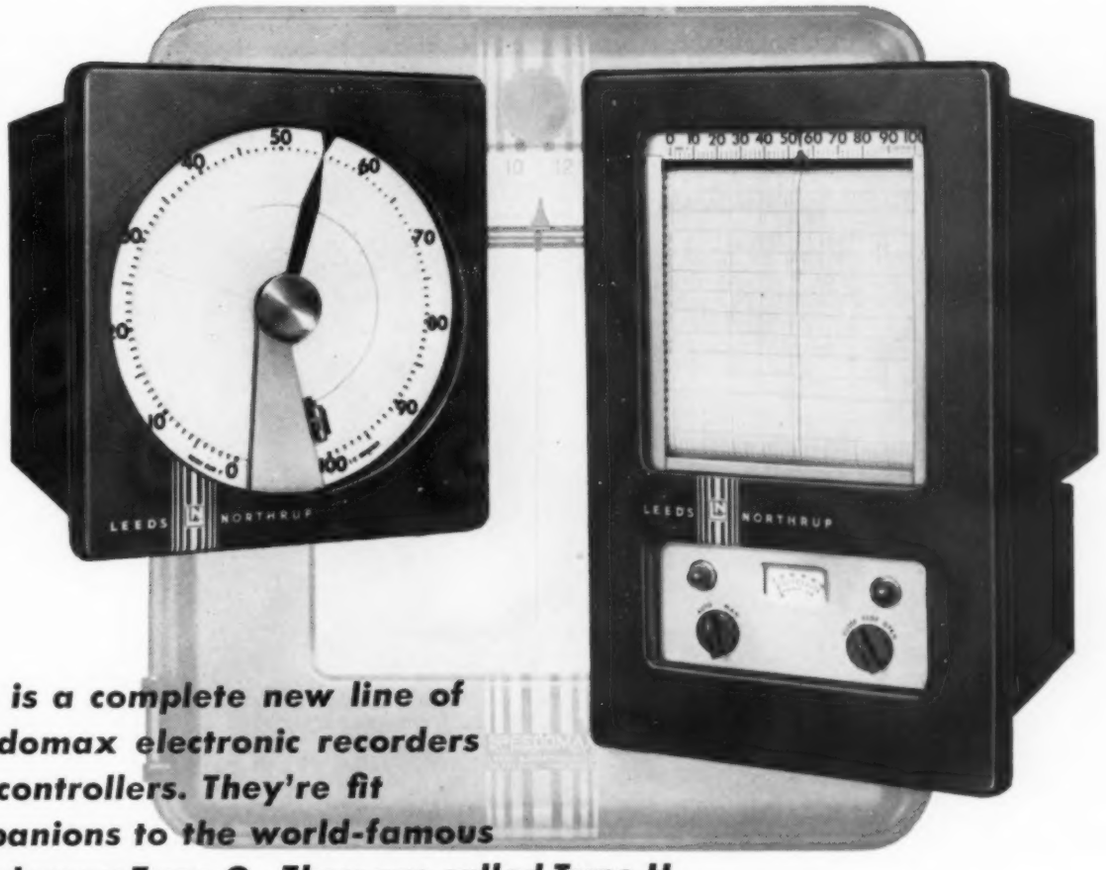
THE Adalet MFG. CO.
14300 LORAIN • CLEVELAND 11, OHIO

New, compact

Speedomax® Instruments can modernize process control in hundreds of plants!



Here is a complete new line of Speedomax electronic recorders and controllers. They're fit companions to the world-famous Speedomax Type G. They are called Type H.

These new instruments can help the operation of a tremendous variety of industrial processes—including many which are perhaps now under-instrumented. And L&N's new production techniques bring Speedomax H equipments within reach of processes which couldn't formerly justify high-quality electronic potentiometers.

Especially significant to operators who now employ filled-system and deflection instruments are the benefits of electronic potentiometer performance. For instance, you can install Speedomax wherever you wish, without a thought for the distance to its sensing element. And Speedomax won't "drift" in accuracy as it ages—it stays on the job and holds the process on spec. If you damage either the sensing element or lead, you simply repair or replace on the job. Speedomax never goes back to the factory for re-calibration, so you do not need spares—thus you save both inventory and storage space.

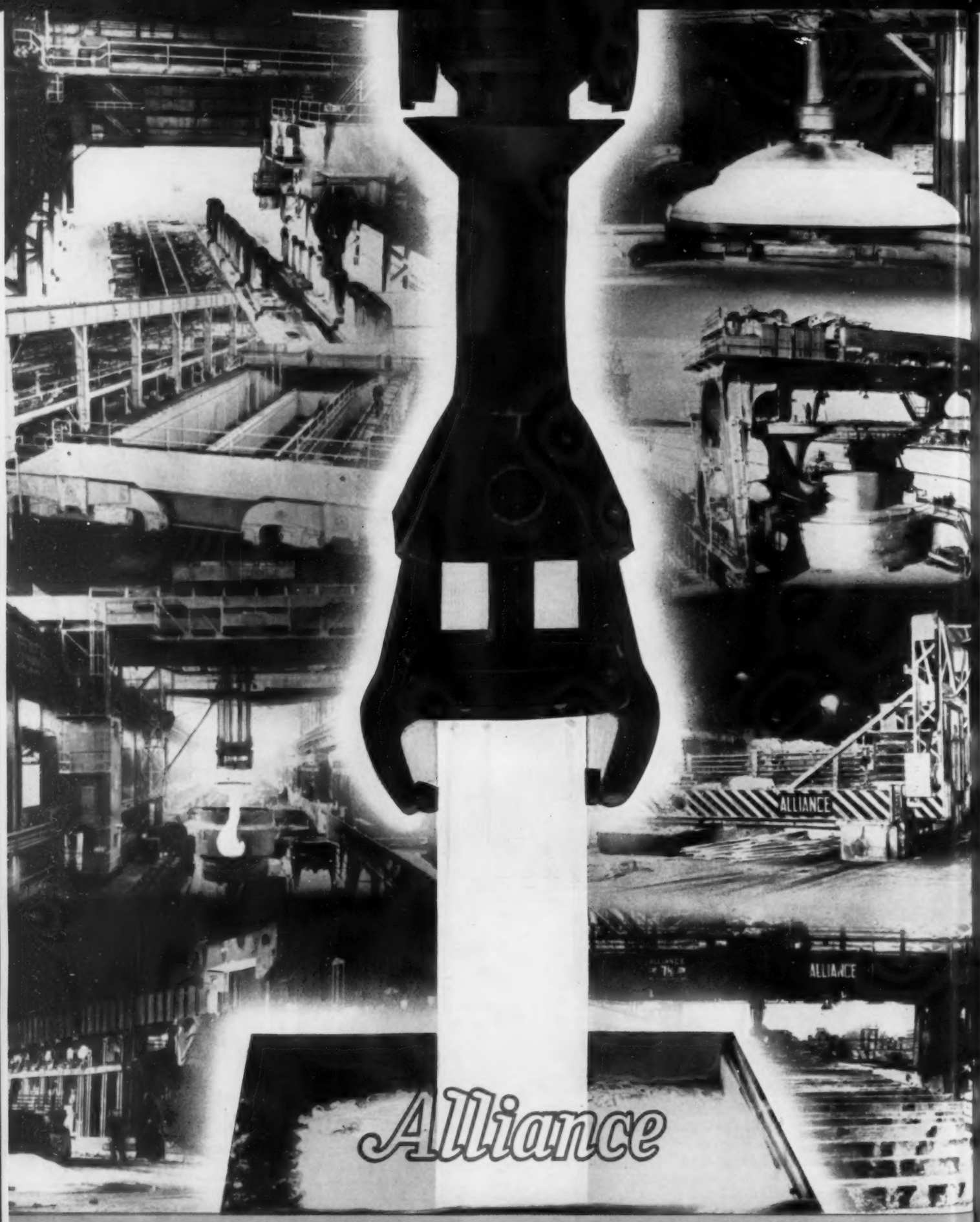
Anyone familiar with L&N construction will see it again in Type H. The same husky components, anti-friction bearings, rigid assembly and ultra-accessability.

New features include a "fill-in-place" pen; a new, ingenious on-off control switch; more plug-in components. External leads go to a terminal board on outside back of case, for easy installation and maintenance.

One of the round-chart instrument's special features is its long scale; this is used both in setting the control point and for reading temperature. All instruments have especially easy, accurate means for moving the control point setter.

You can choose any type of control action—On-off; Proportional Action; Proportional with rate and reset actions. Any L&N office can supply details and application engineering assistance; or write us at 4942 Stenton Ave., Philadelphia 44, Pa.

LEEDS NORTHRUP
instruments *automatic controls* • *furnaces*



THE ALLIANCE MACHINE COMPANY

MAIN OFFICE
ALLIANCE, OHIO · PITTSBURGH OFFICE
1622 OLIVER BUILDING, PITTSBURGH, PA.

LADLE CRANES • GANTRY CRANES • FORGING MANIPULATORS • SOAKING PIT CRANES • STRIPPER CRANES • SLAB AND BILLET CHARGING MACHINES • OPEN HEARTH CHARGING MACHINES • SPECIAL MILL MACHINERY • STRUCTURAL FABRICATION

controls provided, combined with a design and construction that produce an easy steady arc, create a dc machine with the quiet, efficient operation of rectifier welders with the versatility and operating ease of motor generator welders.

Current models available are 300, 400 and 500 ampere ac combined with dc capacities in 200, 300, 375, and 450 amperes.

BUS DUCT

▲ Now available from the Westinghouse Electric Corp.'s Standard Control Division is a bus duct with aluminum bus bars. The new duct, 35 per cent lighter overall than its copper counterpart, has double silver-coated aluminum bars to provide low resistance contacts as joints. It is available in ratings of 225-amperes through 4000-amperes ratings, underwriters approved.

A two-year research and development program in connection with the new duct has shown that best adhesion is obtained when silver is plated on to a silver strike rather than the conventional plating of silver on aluminum. Thus, the aluminum bars are put through a 12-step process which includes an acid dip and a zincate dip in addition to the strike, the electroplating, and various cleaning and rinsing steps. The plating process is designed to eliminate all possibility of electrolytic action.

STRAIGHTENER

▲ The new pipe mill of the Lone Star Steel Co. at Lone Star, Texas, is achieving accurate end-to-end straightening with a seven-roll straightening machine.

A product of Sutton Engineering Co., the straightener, known as the 5 MKTC, is being used for electric welded steel line pipe of from 4½ to 16-in. outside diam at high production speeds of from 60 to 300 fpm.

The straightener operates on the Sutton seven-roll principle in which a large driven roll with two opposed idler rolls is located at the entry end of the machine and another identical cluster is at the delivery end. In these clusters, rolls are positioned at approximately 120 deg to each other. Between these three-roll clusters is an

For every type of shearing machine and every kind of job

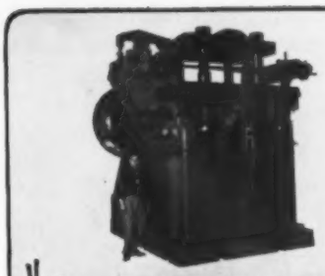
"multicut"
SHEAR BLADES and ROTARY KNIVES

Rx Engineered to the job . . . Every Wapakoneta blade is made to exact specifications, designed for the particular job. Complete records with order number of each blade makes possible duplication of exact size and temper at any time.

"MULTICUT", "TUFCUT", "HOT WORK"

THE WAPAKONETA MACHINE CO.
WAPAKONETA, OHIO.

Knives Engineered for the Job Since 1891



"NO SHUT-DOWNS WITH LUBRIPLATE"
—say HENRY & WRIGHT
of Hartford, Conn.

"While waiting for delivery of one of our 25-ton Dieing Machines to do a particularly heavy job, a customer was trying to start production of a 10-ton machine. Even though it was lubricated with a conventional grease every eight minutes, the machine had to be shut down for bearings to cool during each coil run. Then, on our recommendation, he changed to a LUBRIPLATE Lubricant. With but two applications of LUBRIPLATE a day, the machine operated continuously except during change of coils."

REGARDLESS OF THE SIZE AND TYPE OF YOUR MACHINERY, LUBRIPLATE GREASE AND FLUID TYPE LUBRICANTS WILL IMPROVE ITS OPERATION AND REDUCE MAINTENANCE COSTS.

LUBRIPLATE is available in grease and fluid densities for every purpose . . . LUBRIPLATE H. D. S. MOTOR OIL meets today's exacting requirements for gasoline and diesel engines.

For nearest LUBRIPLATE distributor see Classified Telephone Directory. Send for free "LUBRIPLATE DATA BOOK" . . . a valuable treatise on lubrication. Write LUBRIPLATE DIVISION, Fiske Brothers Refining Co., Newark 5, N. J. or Toledo 5, Ohio.

unopposed pressure roll. This arrangement provides positive confinement of the tube to the pass line without use of guides of any kind.

In all rotary straightening, some loss in collapse strength must be allowed for. With the cluster design, this loss is considerably reduced. Because the tube is surrounded by the cluster rolls during the straightening process, ovality is held to a minimum. This is of particular importance in the production of oil-country tubing.

Automatic coordinated angling of rolls and power operated screwdowns, make extremely rapid size changes possible. Lone Star reports that a change from straightening five in. outside diam tubes to straightening 14 in. outside diam tubes, for example, requires less than two minutes.

From a central control pulpit, a single operator controls his main motor and his straightening speed, making size adjustments by means of three motorized adjusting screws.

The straightener as installed at Lone Star, is powered by a 150/200 hp, 350/1750 rpm, 230 volt, adjustable speed d-c motor. All roll necks, rotating shafts and universal joints are equipped with anti-friction roller bearings. Auxiliary equipment consists of entry and exit tables designed to accommodate lengths of from 20 to 60 ft.

THREAD PROTECTOR

▲ Conduit thread protectors, made of a tough, durable polyethylene plastic, with a bright easily recognized color for each size of conduit, has been introduced by Pittsburgh Standard Conduit Co.

The plastic chosen for this knock-around job was selected because it is resistant to oil and acid, is thermosetting, and will take temperatures up to 185 F. The thread protectors are perfectly fitted so that they will not fall off despite the roughness of the handling. They are, however, extremely easy to take off, a quick slit with a pocket knife doing the trick.

RECTIFIER WELDER

▲ Announced by Hobart Brothers Co. is a new 300-amp d-c selenium rectifier type arc welder with remote control.

The five-range control switch of this welder provides coarse adjustment with generous overlap between ranges to provide dual control. The rheostat, which can be removed for remote control, provides continuous control by adjusting the direct current through the control coils. These controls provide a wide welding current range of 35 to 425 amps for use with a variety of electrode sizes for repair, maintenance and production welding.

A firmly welded core of electrical steel and the absence of moving iron core or adjustable air gaps, assure exceptionally and permanently quiet operation.

For easy handling by crane or hoist a sturdy lifting eye is provided. It can also be supplied with portable mounting.

Book Reviews . . .

▲ **"Simplified Design of Roof Trusses for Architects and Builders,"** by Harry Parker, is published in a second edition by John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., 5 × 7½ in., cloth bound, price $4.00. This second edition includes numerous changes in text relating to design of trusses. New tables have been introduced and examples and figures have been altered and supplemented to bring design procedure up to current practice. It was the primary purpose of this book to present concisely the basic principles and methods underlying the design of structural members used in building construction. It was written for young men who lack technical training and who wish to compute sizes of various structural elements.

▲ **"The Steel Skeleton,"** by J. F. Baker has recently been published by the Cambridge University Press, 32 East 57th Street, New York 22, N. Y. This is Volume I of two volumes which has the sub-title of "Elastic Behavior and Design." The investigations of the Steel Structures Research Committee of Great Britain form the foundation for this volume by describing fully its experimental investigations. This provides real information about the behavior of steel structures, and is a handy tool for every structural engineer. The book contains 206 pp, 7 × 10 in., cloth bound, and sells for $8.50.

▲ **"Nickel in Iron and Steel"** by A. M. Hall, 595 pp, 6 × 9¼ in., price $10.00, cloth bound, was recently published by John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. This book reviews and correlates all the important published data on nickel as an alloying element in steel and cast iron. The first part of the book concerns occurrence and refining of nickel ores, and the remaining part of the book covers topics on the physical properties of steels containing nickel, the structure and heat treatment of wrought and cast nickel steels, and the effect of nickel on various engineering properties. It covers corrosion and welding of cast iron, its tensile strength and hardness, plus many important subjects. Book is second in a new series of Alloys of Iron Monographs, published for the Engineering Foundation with Frank T. Sisco as director.

"Manual of Excellent Managements," 1954 edition, has been published by The American Institute of Management, 125 East 38th Street, New York 16, N. Y. The manual lists 348 excellently managed companies in four basic lists, broken down alphabetically, by industry, geographically and by the Institute's rating within the 348 companies. It contains supplementary lists showing the companies with the greatest growth potential, the best records of stability of net income and the most outstanding outside board of directors. It discusses management audit methods. The purpose of this manual is to compare management records of various companies, industries and areas. The manual contains 96 pages, 8½ x 11-in., cloth bound and can be obtained from the American Institute of Management.

"Chemical Process Principles," by Olaf A. Hougen, Kenneth M. Watson and Roland A. Ragatz was recently published by John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. in a second edition. This is an up-to-date book presenting modern treatment of material and energy balances of chemical processes, utilizing the broad theoretical background necessary for the solution of industrial process problems. The book contains 504 pages, 6 x 9-in., cloth bound and sells for $8.50.

(*Please turn to page 244*)

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SKF Triple-Seal
"SAF" PILLOW BLOCKS

BETTER Because SKF's Type "C" Spherical Roller Bearings . . . .

Increase capacity 25% to 50%
increase service life 2 to 3½ times

The big news in bearings—news from SKF—is the Type "C" Spherical Roller Bearing—as a replacement for ordinary sphericals, size for size, lasts *2 to 3½ times longer, increases capacity up to 50%.*

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Looking for improved methods of tube and pipe making?

At Mannesmann-Meer one of our most recent firsts in mill design is the three-roll arrangement being put to work in stretch reducing mills and continuous mandrel mills. The principle gives smoother outside and inside wall surfaces and better wall tolerances.

But that's only half the story. Along with the three rolls per stand, basic changes in over-all mill design include a revolutionary new mill drive and extremely fast schedule change-over. If you'd like to bring this creative engineering approach to bear on your tube mill plans or problems, why not call on us today? Mannesmann-Meer Engineering & Construction Company, 900 Line Street, Easton, Penna.

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World Specialists in High-Speed Tube Mill Machinery

CHECKING FURNACE COMBUSTION WITH HEAT PROVER. Because it provides direct and continuous readings of oxygen and combustibles, H. Kramer & Company has found the portable Cities Service Heat Prover a great advantage in improving furnace efficiency.

"REDUCED MELTING TIME, INCREASED METAL RECOVERY WITH CITIES SERVICE HEAT PROVER!"

A Report From H. Kramer & Company:

H. Kramer & Company operates brass and bronze ingot smelting and refining plants in Chicago, Los Angeles, and Philadelphia, in addition to offices in most major cities.

Writes Foundry Metallurgist, Fred L. Riddell: "We wish to thank the Cities Service Oil Company for the Heat Prover service they have given us.

"Fuel savings have been substantial, but only incidental to the reduced melting time and considerable increase in metal recovery which afforded greater control over the quality of our product.

"In addition, use of the Heat Prover, has educated our foundry personnel to the point where they are satisfied with only the best operating conditions of all our melting units."

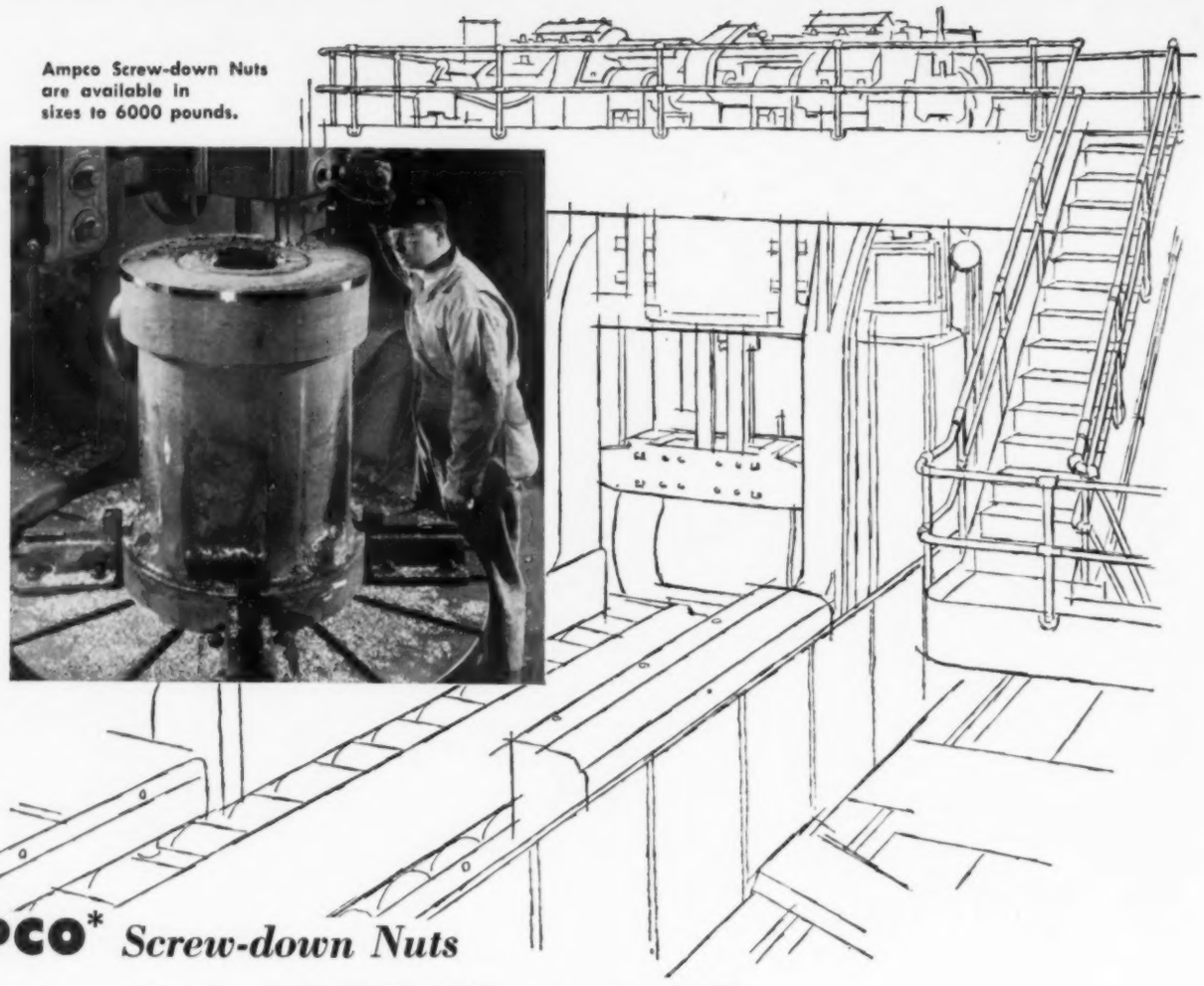
The portable Heat Prover, supplied and maintained free by Cities Service, can help achieve similar results for your furnace operation. For information, contact your nearest Cities Service representative or write Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

HEAT PROVER

FREE—NOT AN INSTRUMENT YOU CAN BUY, BUT A SERVICE WE SUPPLY!



Ampco Screw-down Nuts are available in sizes to 6000 pounds.

AMPCO* *Screw-down Nuts help strip mill* set production record

— handle extreme pressures to avert costly downtime and replacement

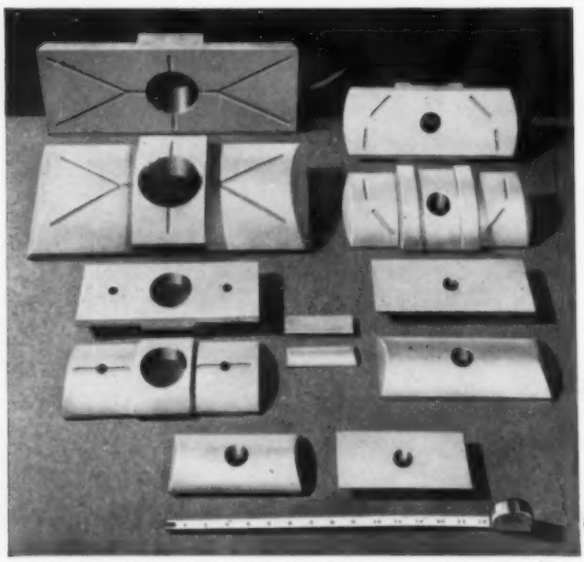
Here's where Ampco Metal's good bearing qualities, high compressive strength and ability to withstand tremendous impact and shock loads really pay off. Ampco Screw-down Nuts eliminate expensive adjustment and downtime . . . don't squash out. For example, one stand of an 80" hot strip mill using Ampco Nuts, utilizes 4500 hp at speeds up to 282 rpm. That means "king-size" stresses and strains. Yet the records show that in spite of normal screw-down pressures of between two and three million pounds, this mill produced over three million net tons of steel in 1953. Virtually no time was lost for screw-down nut replacement or adjustment.

Ampco Screw-down Nuts are centrifugally cast to insure sound structure and good wear resistance. They're available in sizes to 6000 pounds.

And Ampco slippers help keep mills running longer, too, because they have remarkable stamina . . . real resistance to wear and punishing shock loads. Mills that set production records depend on Ampco slippers to end frequent replacement — reduce spindle wear.

Slippers are available as rough castings or "cast-to-size" — minus 0, plus 1/32" or plus 0, minus 1/32". Oil grooves are cast in — if you want them.

Find out how these and other Ampco products provide real dollars and cents savings in *your* mill. Contact your nearest Ampco field engineer or write us direct.



Ampco Slippers available either as rough castings or "cast-to-size." Oil grooves can be cast in.

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Sole producer of genuine Ampco Metal

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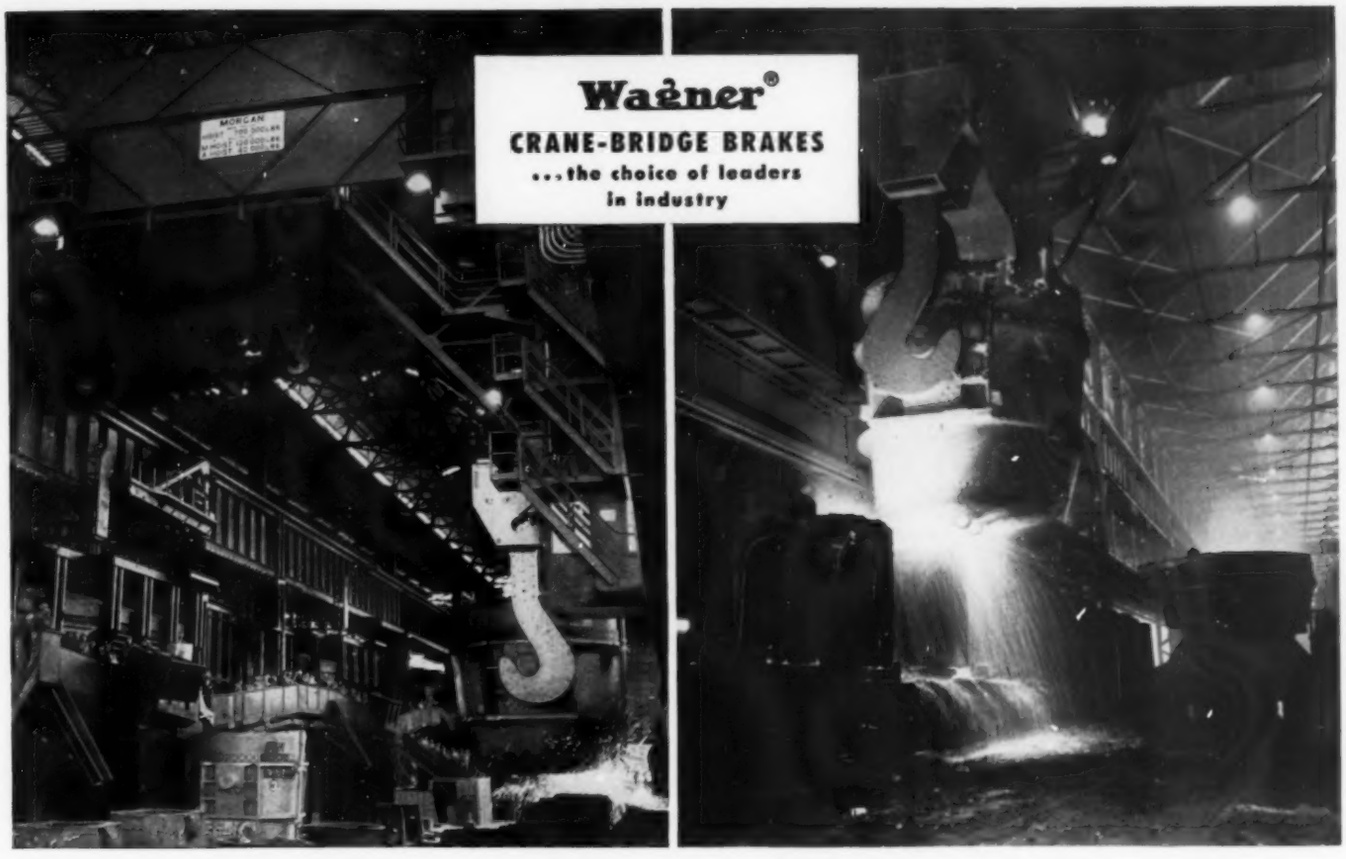


Wagner®
CRANE-BRIDGE BRAKES
...the choice of leaders in industry

STOPPED...RIGHT ON THE BUTTON with Wagner Powered Hydraulic CRANE BRIDGE BRAKES

The cranes in the picture above are installed at Jones & Laughlin Steel Corporation's Open Hearth No. 4.

The ladle-carrying crane is "spotted" over the molds by Wagner *Powered* Hydraulic Crane Bridge Brakes, one of which is shown in the inset below.

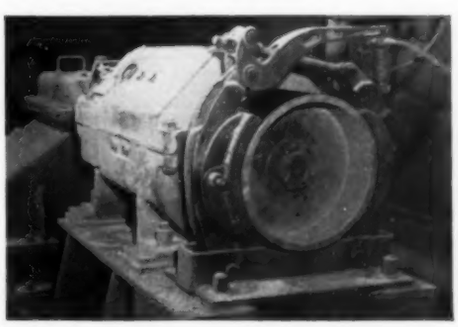
Leaders of industry such as Jones & Laughlin have installed Wagner Crane Bridge Brakes because they're:

SAFE... cranes can be controlled without bridge motor plugging and the resultant damage to both motor and gears... parking brakes set automatically to bring the crane to a gradual stop in case of power failure.

EFFICIENT . . . Wagner Crane Bridge Brakes allow close spotting where frequent stops and starts are necessary... a self-centering device prevents brake shoe drag by automatically clearing the brake shoes.

EASY-TO-OPERATE... tip-toe braking... finger-tip parking... one-minute bleeding.

ECONOMICAL . . . operators are less likely to drag brakes so there is less wear on wheels and lining... the life of your equipment is prolonged... several brakes can be operated from one pedal... it is easy to step up production.



Wagner power units can be added to your present Wagner Hydraulic System. Only six weeks are required to fill the average order. Bulletin IU-36 gives full details —write for your copy today.

Wagner Electric Corporation EST. 1891

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ELECTRIC MOTORS
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155-1

Modern Steel Makers Maintain Control with RCA Industrial TV

Production records are being made through mill supervision by RCA Industrial TV . . . On an 80" mill that holds the world's record for hot strip, a camera over the mill and a TV screen on the control pulpit permit the operator to detect threats of pile-ups, or other troubles, before damage occurs. One pile-up on a strip mill can mean as much as 15 minutes of lost production time or 120 tons of steel . . . so it pays off handsomely to KNOW, not GUESS.

Many Uses. Other uses include RCA Industrial TV to observe furnace conditions, heat treating, charging, crane movement, and other hazardous or inaccessible operations . . . wherever it's important to *see* where you cannot *look*.

Direct-Observation Clarity. With RCA Industrial TV you attain the accuracy of direct observation without danger or inconvenience. You see a high-definition, high-contrast picture that's best for efficient centralized control, and all camera adjustments are conveniently made at the viewing monitor.

Survey Without Obligation. Let us make a survey of your Industrial TV requirements without obligation. RCA's practical Service Plan provides for service by experienced factory-trained engineers. Use coupon below for literature.

RCA CAMERA . . . compact, rugged, built to give reliable service under rough operating conditions. Uses the sensitive RCA-developed time-proved Vidicon tube, reducing weight to a minimum.

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ACCESSORIES . . . include water-cooled camera lens, explosion-proof housing, panel-mounting monitor, camera switcher, industrialized auxiliary viewer, remote iris, remote focus, pan and tilt assembly and other field-proved equipment.

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LOOKING FOR WAYS TO CUT SLAG HANDLING COSTS?

the answer is here!

JOHNSTON CORRUGATED CINDER POTS

...HAVE LONGER LIFE... *they outlive other pots... proved by records*

...PROVIDE FASTER TURN-AROUND TIME

...LOSE LESS TIME AT THE SLAG PIT *through easier, speedier, cleaner dumping.*

...REDUCE MAINTENANCE TO A MINIMUM... *base suspension of the pot eliminates distortion and breakage.*

These are the ways Johnston Cinder Pots can assure lower cost-per-ton slag handling. They are available for blast furnace, open hearth or electric furnace operations—in sizes to serve all slag handling operations.

MACKINTOSH-HEMPHILL COMPANY

Makers of the rolls with the striped red wabblers

PITTSBURGH AND MIDLAND, PA.

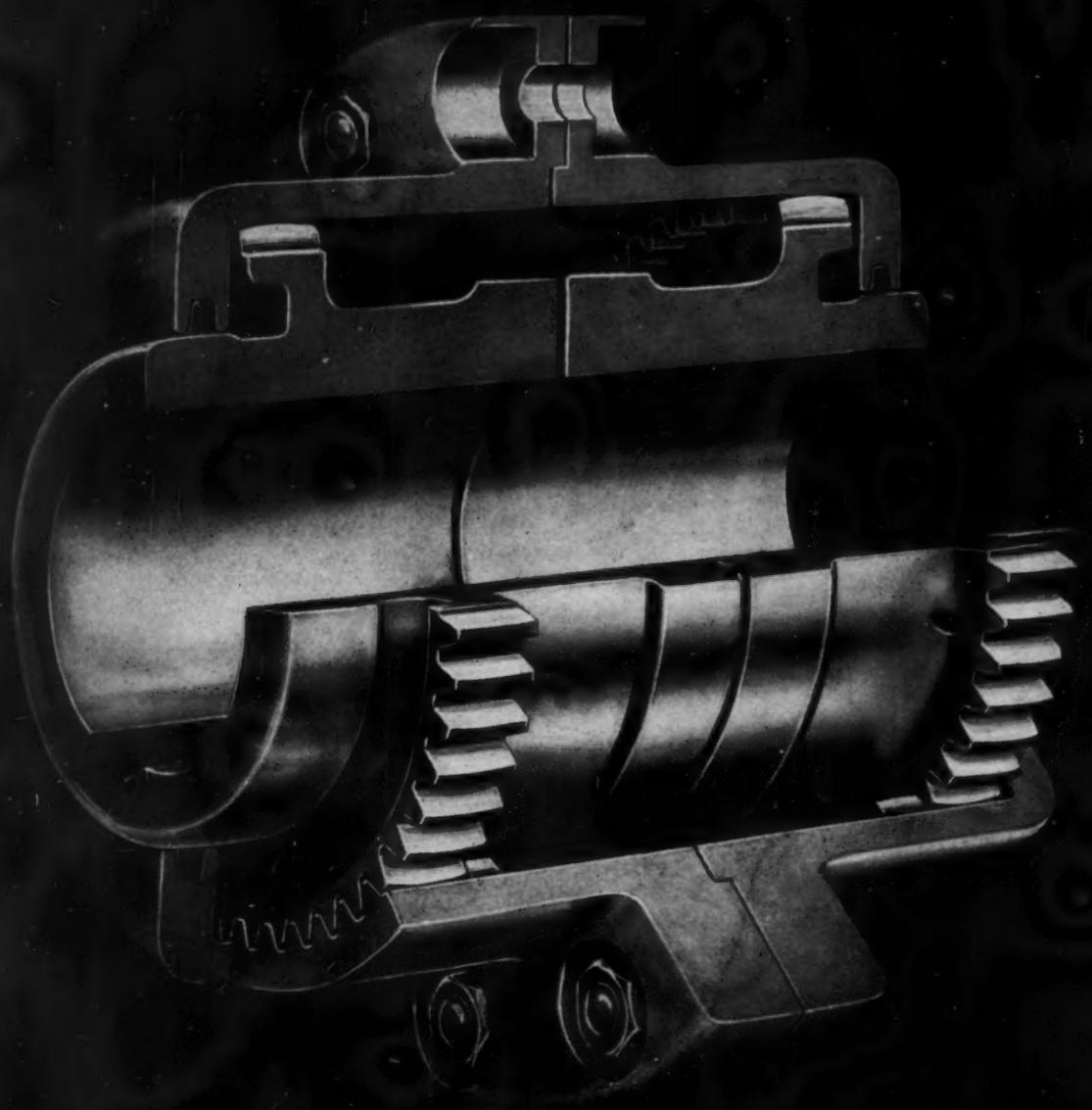
MACKINTOSH-HEMPHILL PRODUCTS INCLUDE: all types of cast mill rolls . . . improved Johnston patented corrugated cinder pots and slag handling equipment . . . Mackintosh-Hemphill rotary straighteners . . . electronically controlled contouring lathes . . . screw feed roll turning lathes . . . heavy duty engine lathes . . . shears . . . end-thrust bearings . . . steel and special alloy castings . . . reversing hot strip mills . . . Y-type cold strip mills.

MAKE THIS TEST

Place Johnston Corrugated Cinder Pots side by side with other pots on your slag train. Give them the same treatment day by day. Be sure to keep a record of performance. It won't be long until you'll convince yourself that for lower costs you must join the *trend* to Johnston Corrugated Cinder Pots.

Write today for the bulletin describing and explaining all the features of Johnston Corrugated Cinder Pots.

POOLE



A COPY OF CATALOG GIVING FULL DESCRIPTION AND ENGINEERING DATA SENT UPON REQUEST.

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POOLE FOUNDRY & MACHINE COMPANY

WOODBERRY, BALTIMORE, MD.

ROLLS HARDENED
7 to 12 times faster

SELAS RADIANT PRECISION HEAT SPEEDS
HARDENING . . . ASSURES UNIFORM HARDNESS

Roll hardening has been speeded up 7 to 12 times faster than ordinary methods with the new Selas Radiant Heat Roll Furnace. Harmful scale eliminated. A uniform pattern of hardenability attained. The shoulders of the roll not affected.

Lined with Selas radiant heat burners this new gas furnace precisely patterns heat and hardens rolls up to 60 inches in diameter. Rolls are rotated during the heating and quenching cycles. When the heating cycle is finished furnace halves are easily rolled back on tracks . . . roll is quickly quenched. Result . . . no harmful scale formed . . . no soft spots.

Selas engineers working throughout the metal industry have speeded up heat treating, metal fusion, brazing, forging and other operations by scientifically applying radiant gas heat. Let them help you speed up your production, reduce costs and improve quality with Selas heat processing equipment . . . engineered to your production line. Write for booklet on radiant heat.

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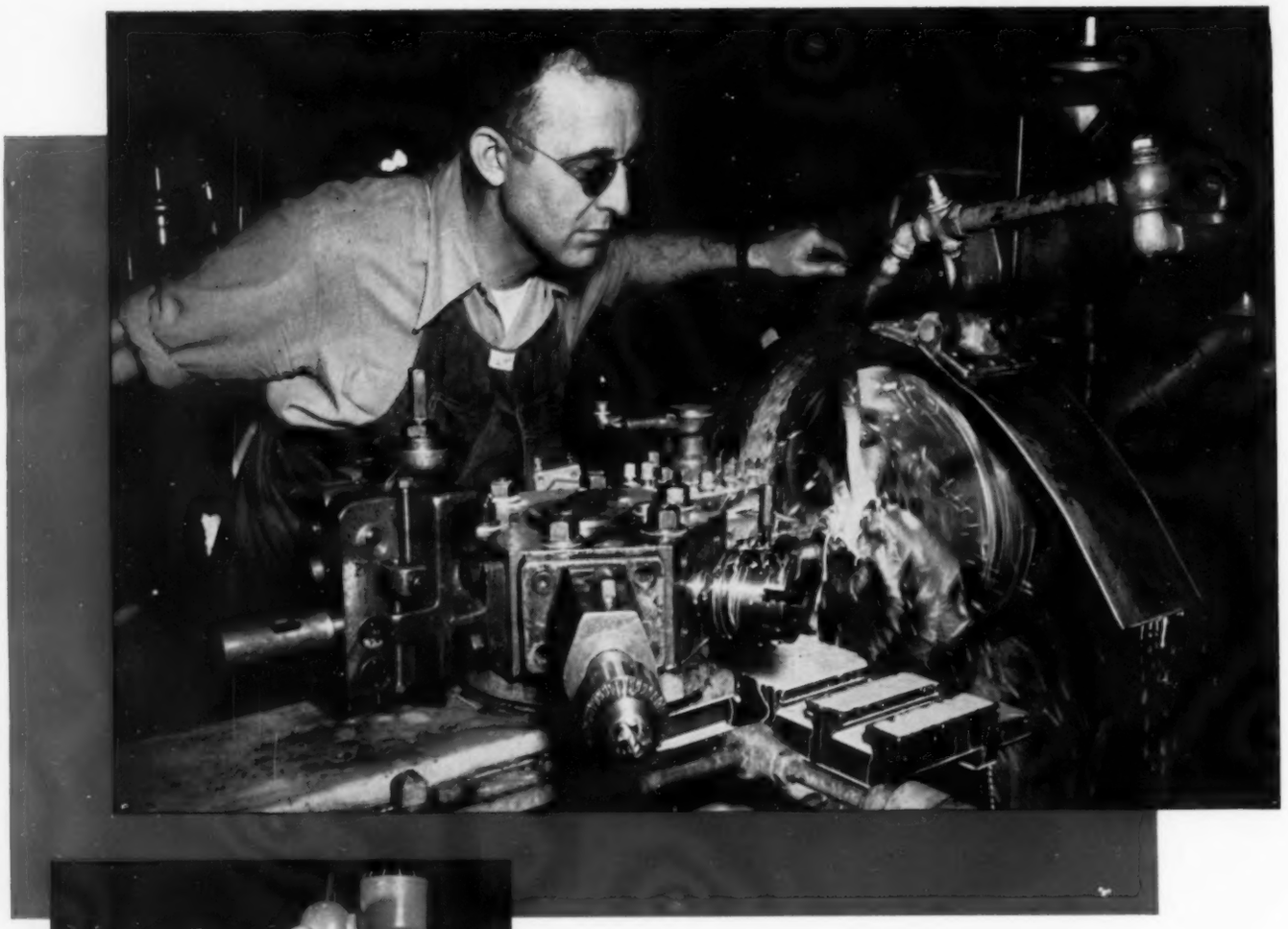
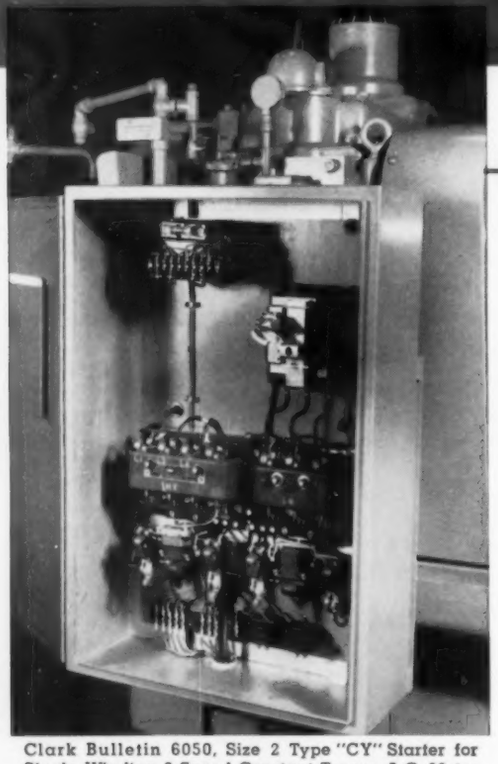
Heat Processing Engineers for Industry • Development • Design • Manufacture





Clark Bulletin 6050, Size 2 Type "CY" Starter for Single Winding 2 Speed Constant Torque A.C. Motor used on Warner & Swasey Universal Turret Lathes.

CLARK CONTROLS help Warner & Swasey lathes

"machine better, faster, for less"

● Selected for long, trouble-free performance, Clark Bulletin 6050 Size 2, Type "CY" 2-speed starters are used on Warner & Swasey's No. 5 Universal Turret Lathes. Maintenance and wear on contact tips are reduced to a minimum as a result of an exclusive arc quenching method employed on Type "CY" starters. Effective arc interruption and reduced wear on tips is accomplished by using strong multi-turn magnetic blowouts and double-break contacts. Forced rotation continuously moves the arc from a hot to a cold spot, distributing the heat evenly over entire contact, preventing pitting or "build-up." Tips require no cleaning or dressing over long years of maintenance-free operation.

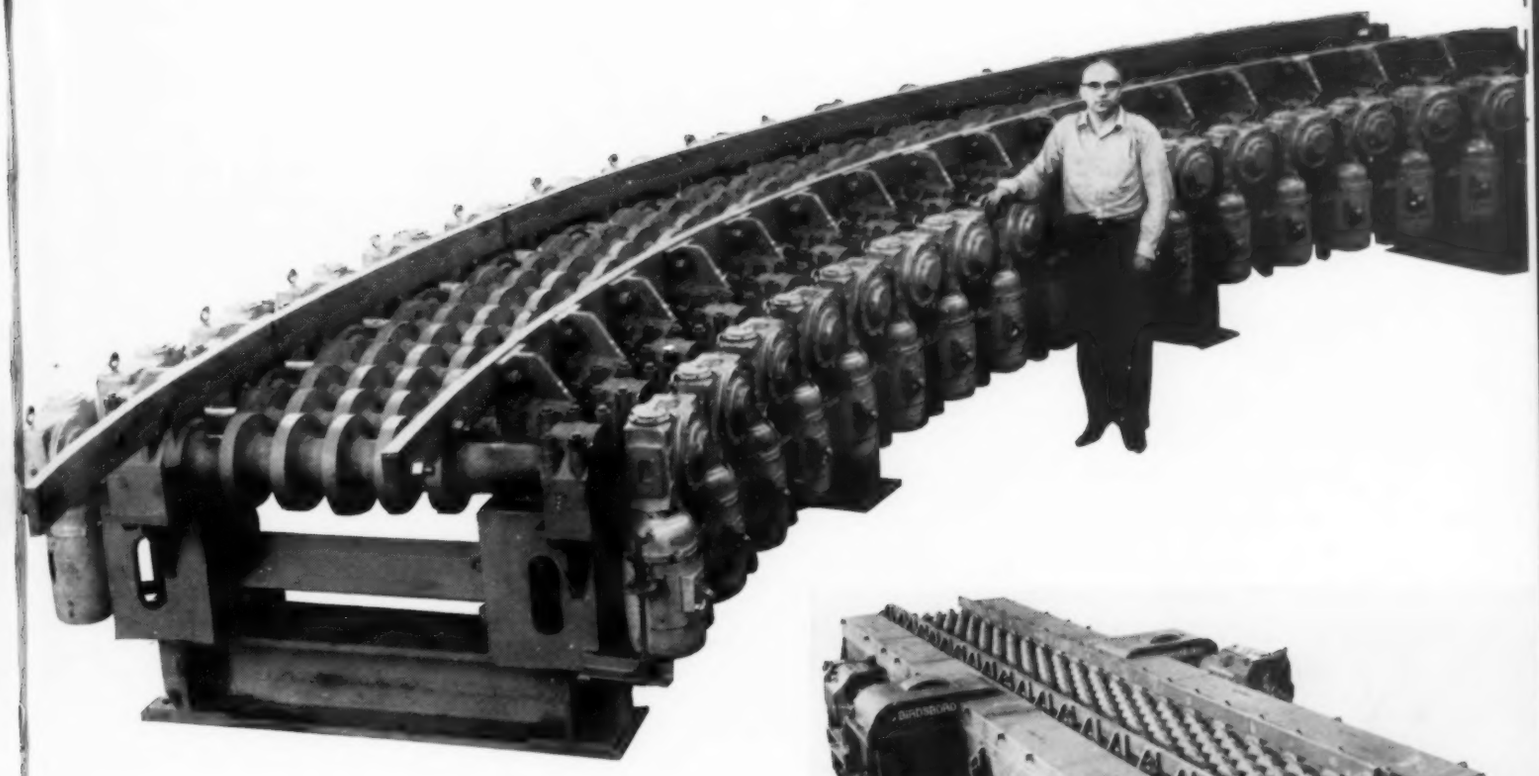
Write for complete descriptive literature.

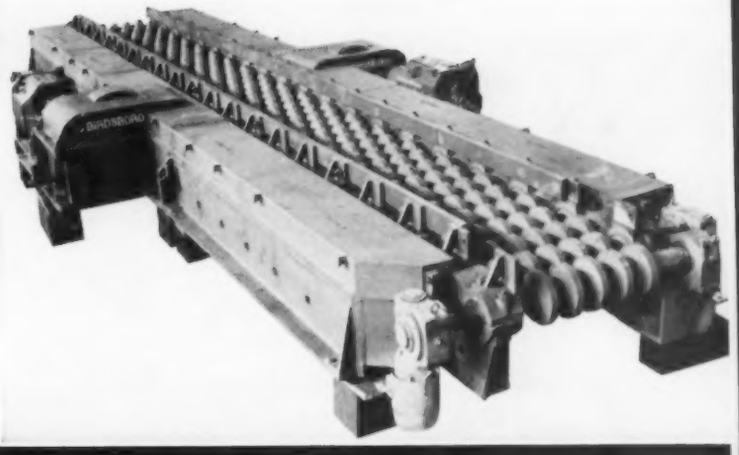
The **CLARK** **CONTROLLER** *Company*

Engineered Electrical Control

1146 East 152nd Street • • Cleveland 10, Ohio

Plate mill auxiliaries . . .





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SPECIAL MACHINERY
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BOOK REVIEWS

(*Continued from page 231*)

"**Mathematics at Work,**" by Holbrook L. Horton, published by The Industrial Press, New York 13, N. Y., was written as a result of many letters asking for assistance in solving specific problems which were basically mathematical in character and relating to mechanical work. This book is of great help to men in the shop and drafting room to illustrate just how fundamental mathematical principles and methods of solution are applied. Book emphasizes practical application of mathematics to practical problems, 726 pages, 6 x 9-in., and is cloth bound.

"**The Cupola and Its Operation,**" was published in a second edition in 1954 by the American Foundrymen's Society, Inc., 616 South Michigan, Chicago 5, Ill., 332 pp., 8½ x 11-in., cloth bound. This book is the result of work done by the Cupola Research Committee of the American Foundrymen's Association who put out the first edition in 1946. The book presents clearly and simply a complete practical picture of cupola operation techniques as well as necessary information which the foundryman needs for the auxiliary equipment. A very extensive bibliography on cupola practice is also a part of this work. This book is highly recommended.

"**Welding for Engineers,**" by Harry Udin, Edward R. Funk, and John Wulff, 430 pp., cloth bound, price $7.50 was recently published by John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. This book is written to give the reader a thorough appreciation of welding as an art and science. It provides a lucid presentation which should equip the engineer with information that will enable him to deal with a wide variety of actual welding problems. Through use of principles from physics, mathematics, chemistry, metallurgy and mechanical engineering, the authors set forth an understanding which extends to not only welding and joining, but to other arts in the general field of metal fabricating.

"**The Seamless Story,**" by James Percy Boore was recently published by The Commonwealth Press, Inc., 1507 DeLong Street, Los Angeles 15, California, 285 pp, 6 x 9-in., cloth bound. This history of seamless is the result of a great deal of research and investigation by the author who has extensive experience in all phases of the manufacture and merchandising of tubing. This book presents in an interesting manner the background of tubing including the invention, the story of the inventors, the development of the product, and biographies of the personalities in the seamless tubing industry. It covers also an outline of contemporary mills and how they developed.

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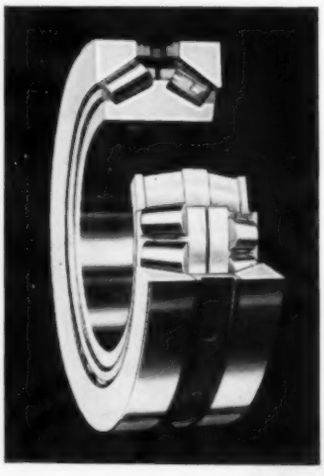

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No. 162

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Free Lubrication Survey

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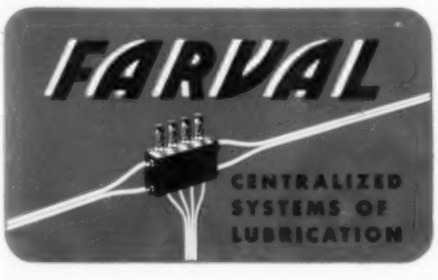

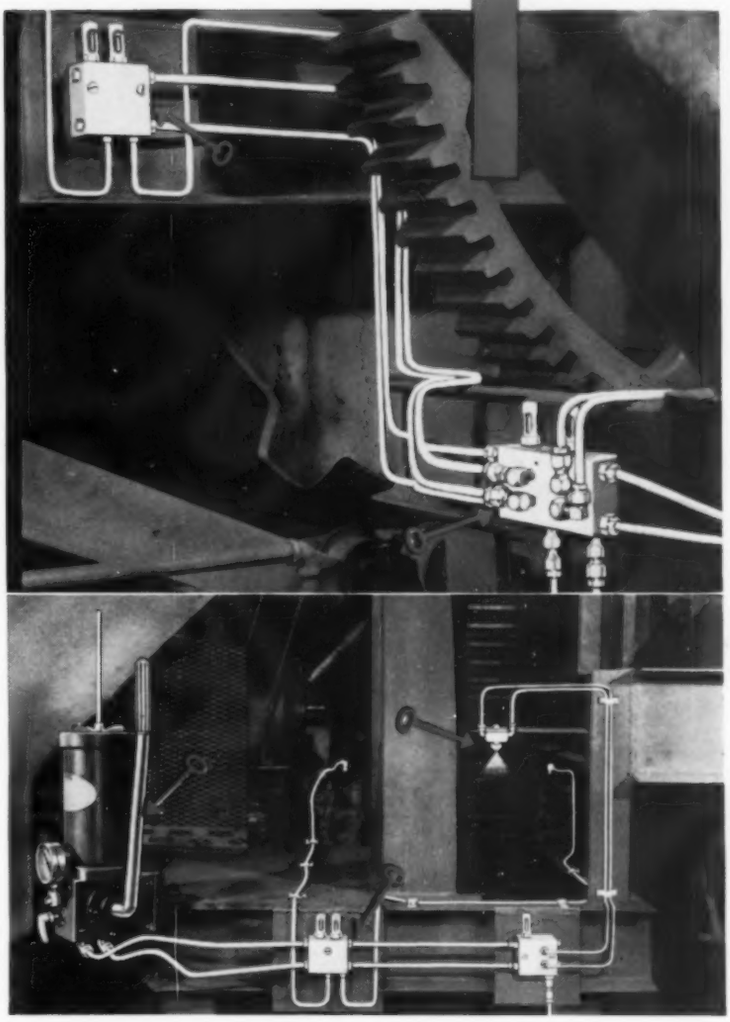

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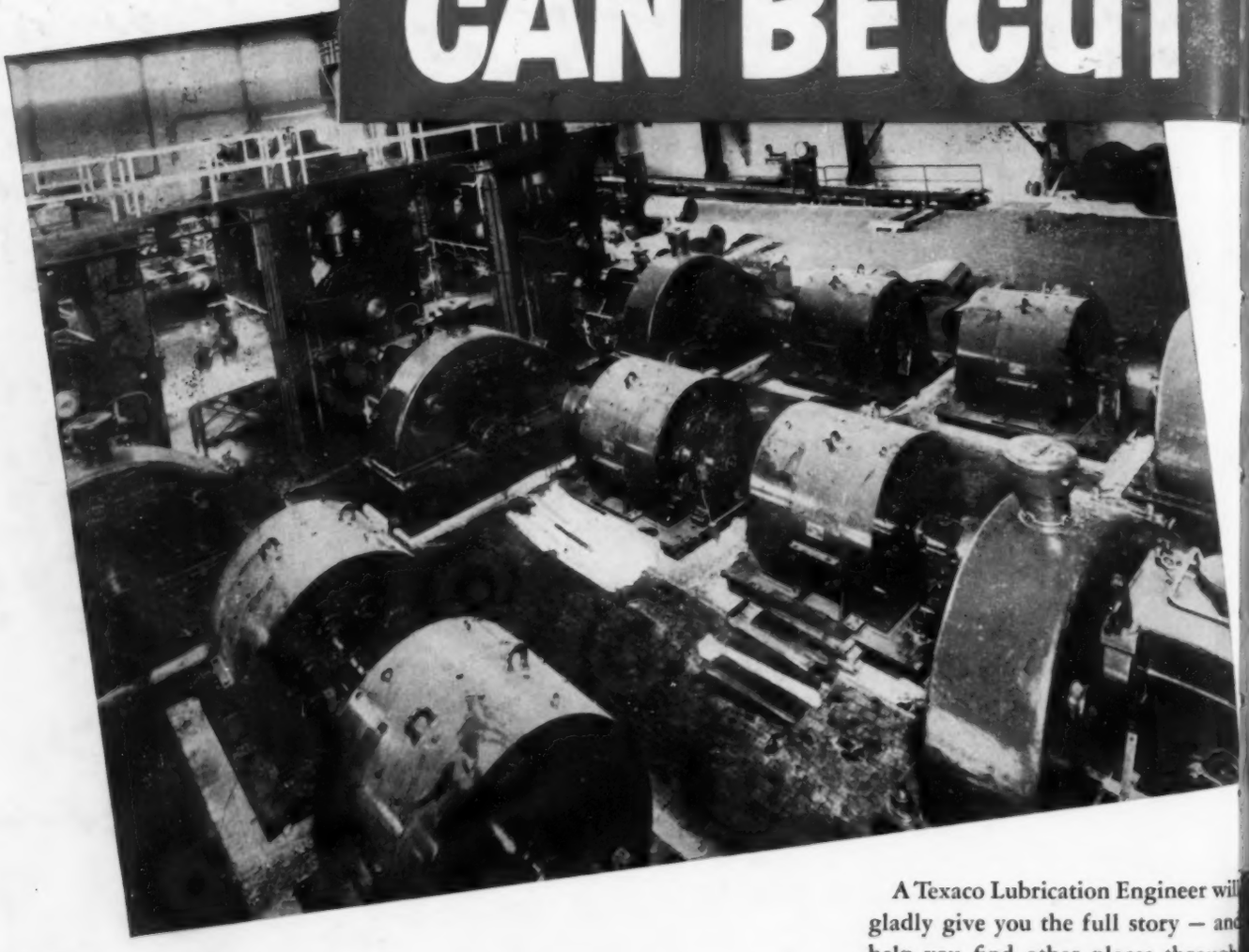

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